

CLASSIFICATION CHANGE

UNCLASSIFIED

To CP-4 Date 12/2/72
By authority of [redacted] NASA
Changed by [redacted]
Classified Document Master Control Station
Scientific and Technical Information Facility

GROUP 4

APOLLO

SECOND QUARTERLY STATUS REPORT

5-62 AP 11573

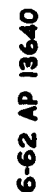
SCOPE OF REPORT

- PROGRAM STATUS
- SELECTED NONTECHNICAL SUBJECTS
- SELECTED TECHNICAL SUBJECTS

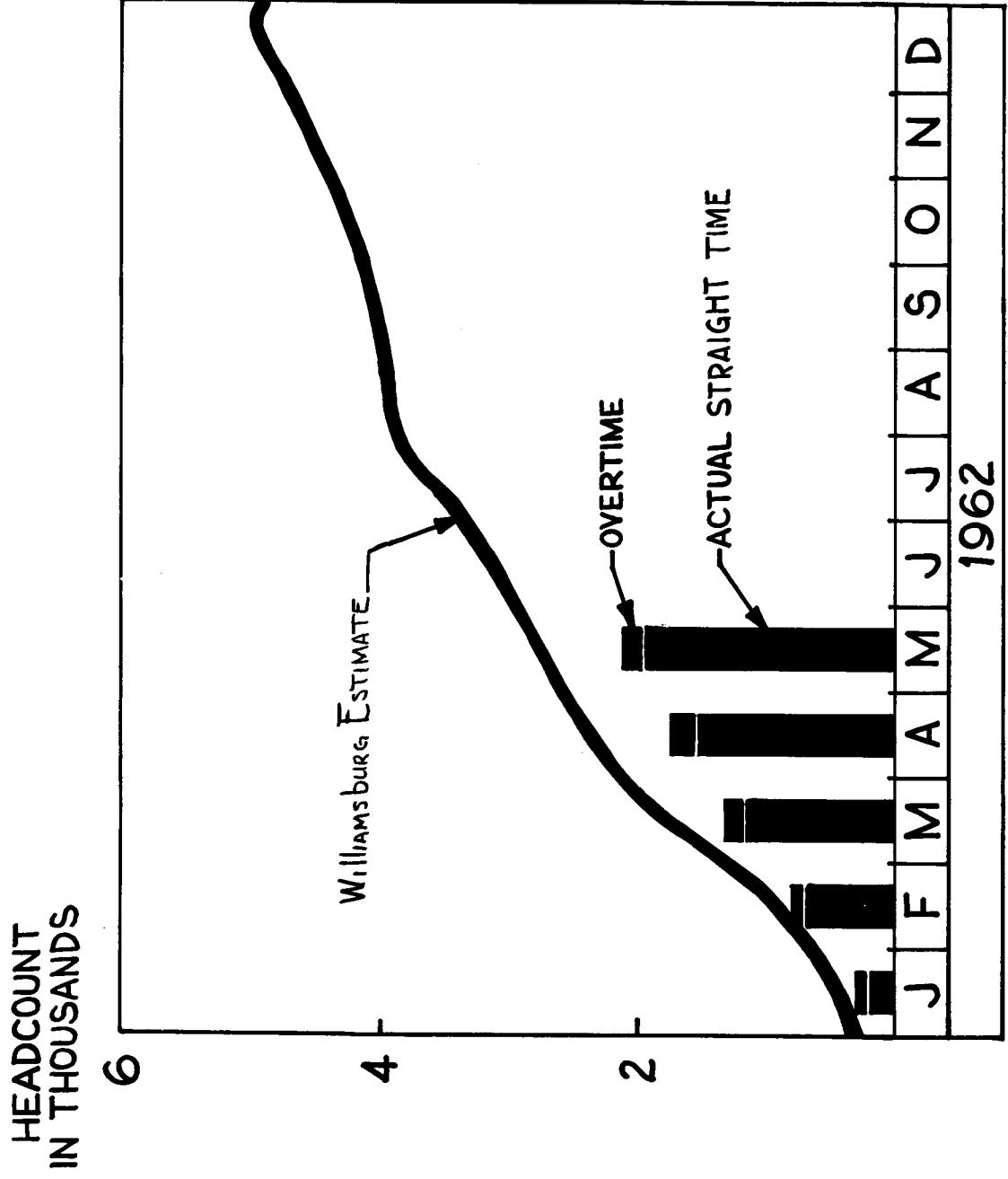
PROGRAM STATUS

- MASTER PHASING PLAN
- MANPOWER & ORGANIZATION
- HARDWARE STATUS
- FACILITIES
- MAJOR EVENTS
- COST

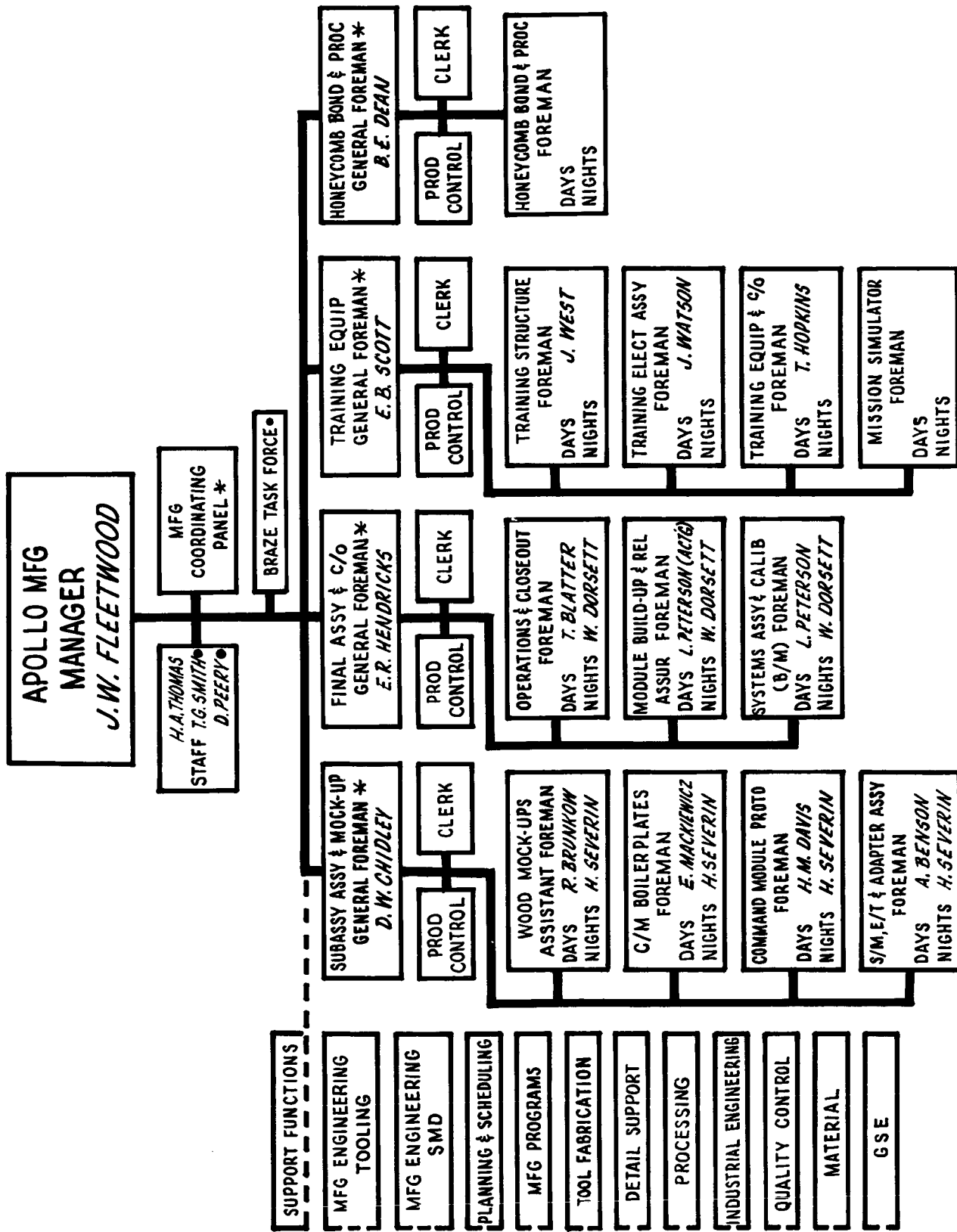
6-62 AP 13634



APOLLO PROGRAM DIRECT LABOR TOTAL PROGRAM



ORGANIZATION



PERSONNEL TRAINING

- **CURRENT ACTIVITY**

CERTIFICATION TRAINING

WELDING

SOLDERING

- **PLANNED ACTIVITY**

INDOCTRINATION PROGRAM

APOLLO MISSION & OBJECTIVES

NAA APOLLO CONFIG & HARDWARE RESPONSIBILITIES

APOLLO MFG ORGANIZATION FUNCTIONS

PROJECT DEMANDS OF RELIABILITY

GROUND SUPPORT EQUIPMENT

TRAINER SIMULATOR

GENERAL TECHNICAL TRAINING

SKILLS & PROCESS TRAINING (NONCERTIFICATION)

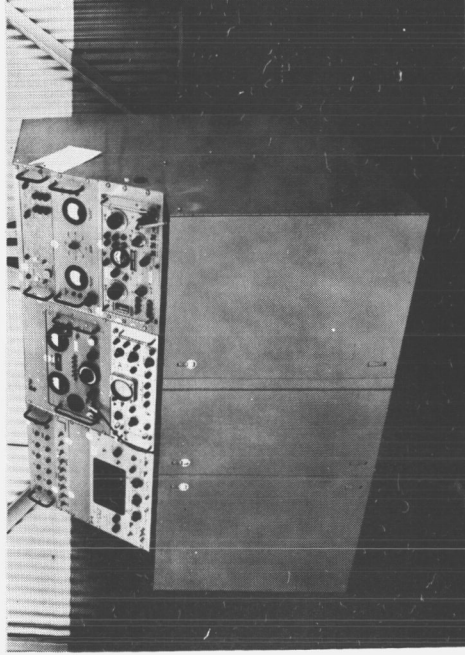
CHECKOUT TRAINING

CURRENT TOOLING ACTIVITY

• TOOL DESIGN	
DESIGNS IN WORK	98
DESIGNS COMPLETE	28
• TOOLING FABRICATION	
PLASTER MASTERS	
IN WORK	7
COMPLETE	8
DIMENSIONAL TOOLS	
IN WORK	5
COMPLETE	11
ROUGH STRUCTURES	
IN WORK	17
COMPLETE	38

SYSTEMS MEASURING DEVICES

REQD TO SUPPORT FACTORY SYSTEMS
INSTALLATION & CHECKOUT



- TEST EQUIP. IDENTIFIED
217 ITEMS
- TEST EQUIP. ORDERED
104 ITEMS

FABRICATION

	AS OF 31 MAY		JUN - JUL
	SCHEDULED	ACTUAL	SCHEDULED
• MOCK-UPS IN WORK	9	9	13
• BOILERPLATES IN WORK	8	8	11
• PRODUCTION ORDERS ISSUED		2193	4400

GROUND SUPPORT EQUIPMENT

- **CURRENT EFFORT**
 - PREPLANNING**
 - RELOCATION & EXPANSION OF FABRICATION DEPTS**
 - INITIAL SUPPORT PROGRESS**
 - COMPOSITE SCHEDULES ISSUED**
 - SCHEDULE KEY & INDEX CHART PREPARED**
 - DWG RELEASES PROCESSED**
- **FUTURE EFFORT**
 - FABRICATE INITIAL BOILERPLATE SUPPORT ITEMS**

SPECIFIC HIGHLIGHTS OF MFG PROGRESS

- **STUDY & EVALUATION OF ADVANCED PROGRAM METHODS
TO REDUCE COST & IMPROVE SPACECRAFT DESIGN**

TECHNIQUES UNDERGOING STUDY

ELECTRON BEAM WELDING

HIGH-ENERGY FORMING

STRESS SKIN PANELS

STEEL HONEYCOMB BRAZING

TASK FORCE FORMED

PLAN OF ACTION GENERATED

SUBCONTRACTORS BEING EVALUATED

- **OTHER TASKS ACCOMPLISHED**

5 MOCK-UP STRUCTURES COMPLETED

SIMULATOR NO.1 (BETA MOCK-UP) COMPLETED

PROGRAM REVIEWED RESULTING IN DELETION OF CERTAIN

MOCK-UP & BOILERPLATE ARTICLES

REVISED MFG PLAN

SUMMARY

FUTURE ACTIVITIES

- **• COMMENCE FAB OF 4 MOCK-UPS & 4 BOILERPLATES**
- **• COMPLETE FAB OF 6 MOCK-UPS & 1 BOILERPLATE**
- **• CONTINUE EVALUATION & DEVELOPMENT OF IMPROVED MFG METHODS**
- **• CONTINUE PREPLANNING & TOOLING FOR SUBSEQUENT ARTICLES**
- **• TRAINING PERSONNEL**

APOLLO FACILITIES

SECOND QUARTERLY STATUS REPORT

APOLLO

FACILITIES PREPARATION SCHEDULES

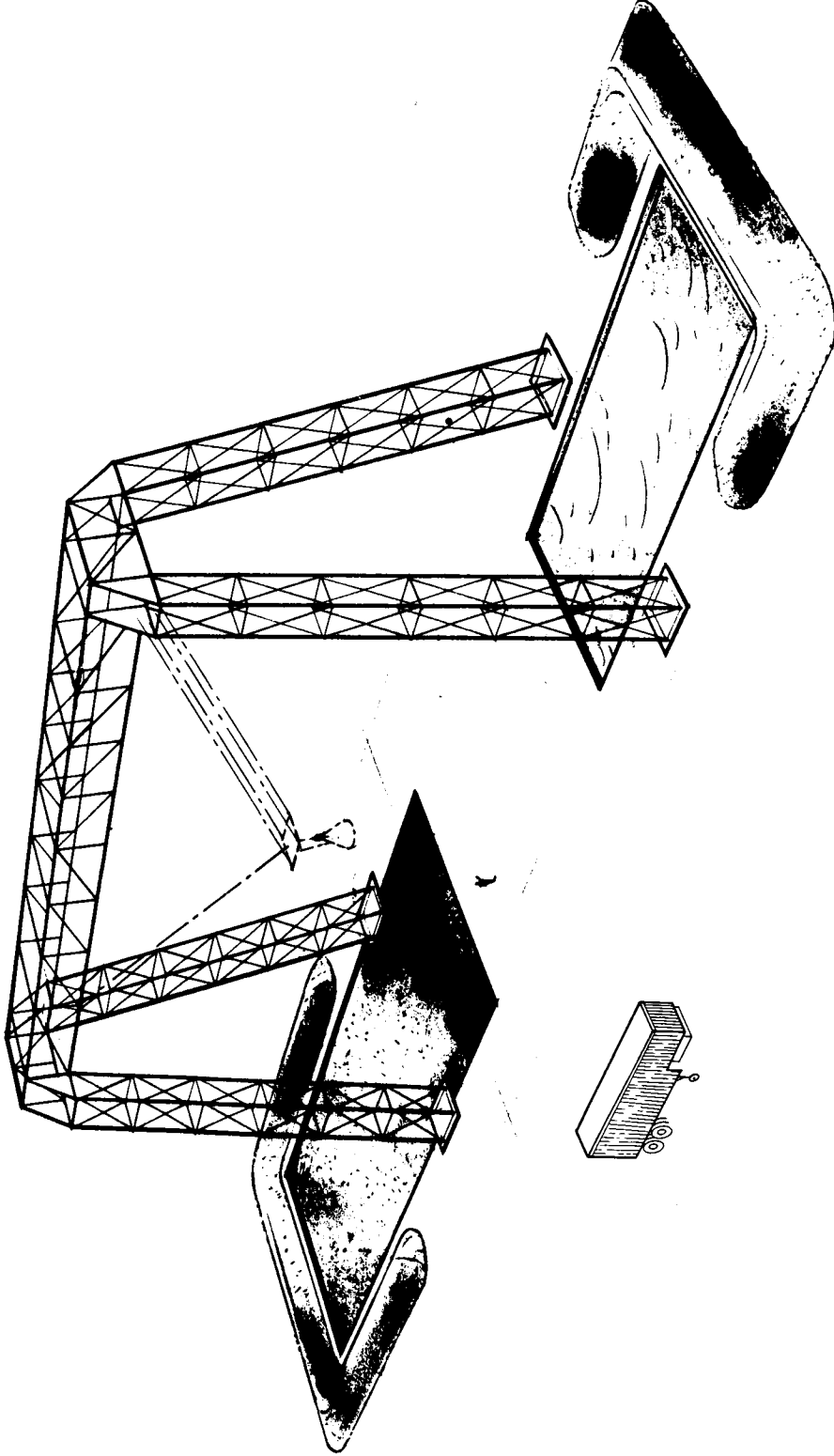
CRITICAL PROBLEMS

- IMPACT
- BONDING
- BLDG. 6 ADDITION
- PROPULSION DEVELOPMENT

SCHEDULE GROUND RULES

- PHASED DESIGN, ADMINISTRATION,
& CONSTRUCTION ACTIVITIES
- ADVANCE SUB-CONTRACTOR FOR STEEL,
SITE, FOUNDATIONS & EQUIPMENT
- ACCELERATED ADMINISTRATION &
FUNDING ACTIONS
- CONCURRENT AGENCY ACTIONS

IMPACT TEST

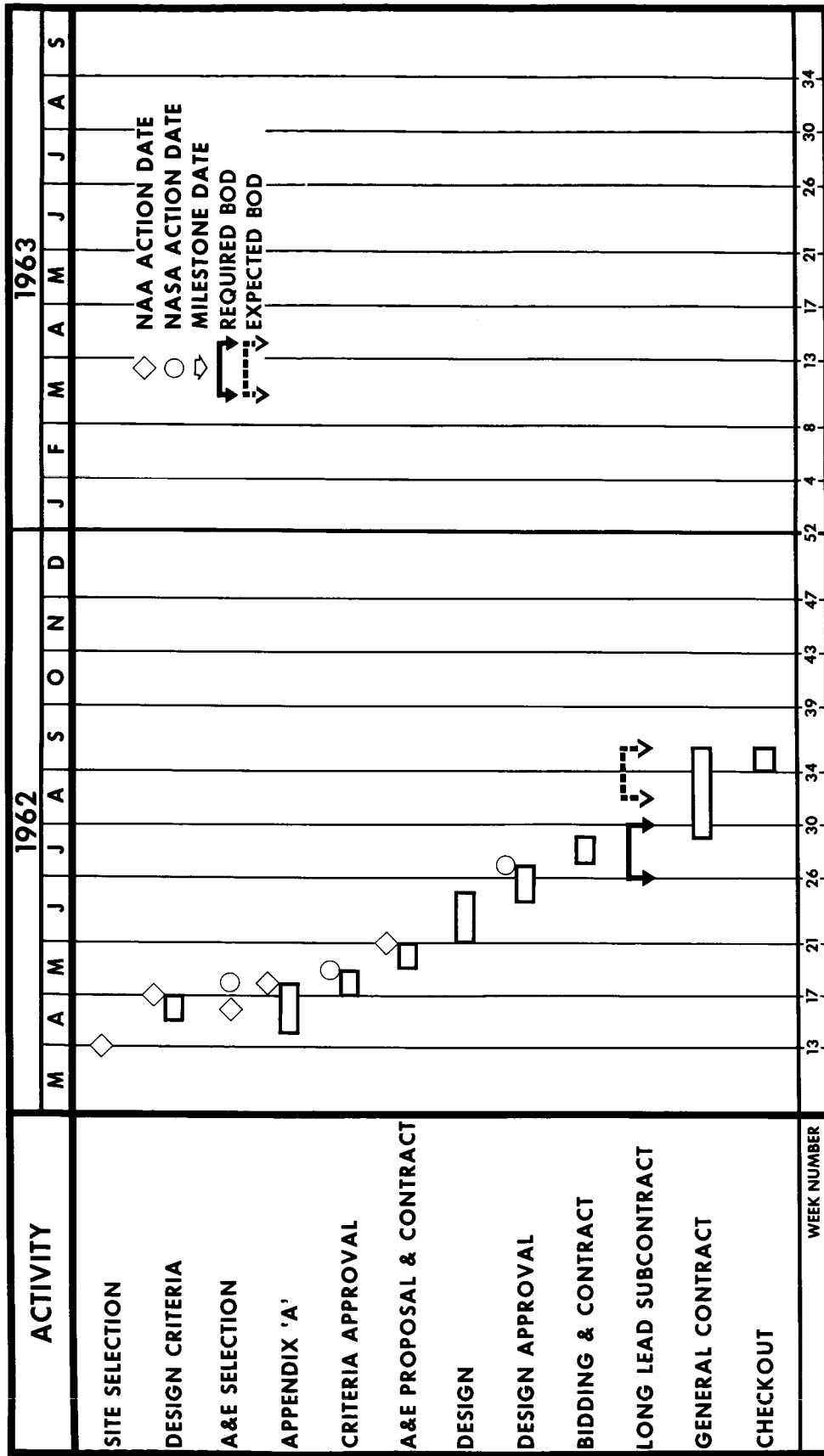


NORTH AMERICAN AVIATION, INC.
SPACE AND INFORMATION SYSTEMS DIVISION

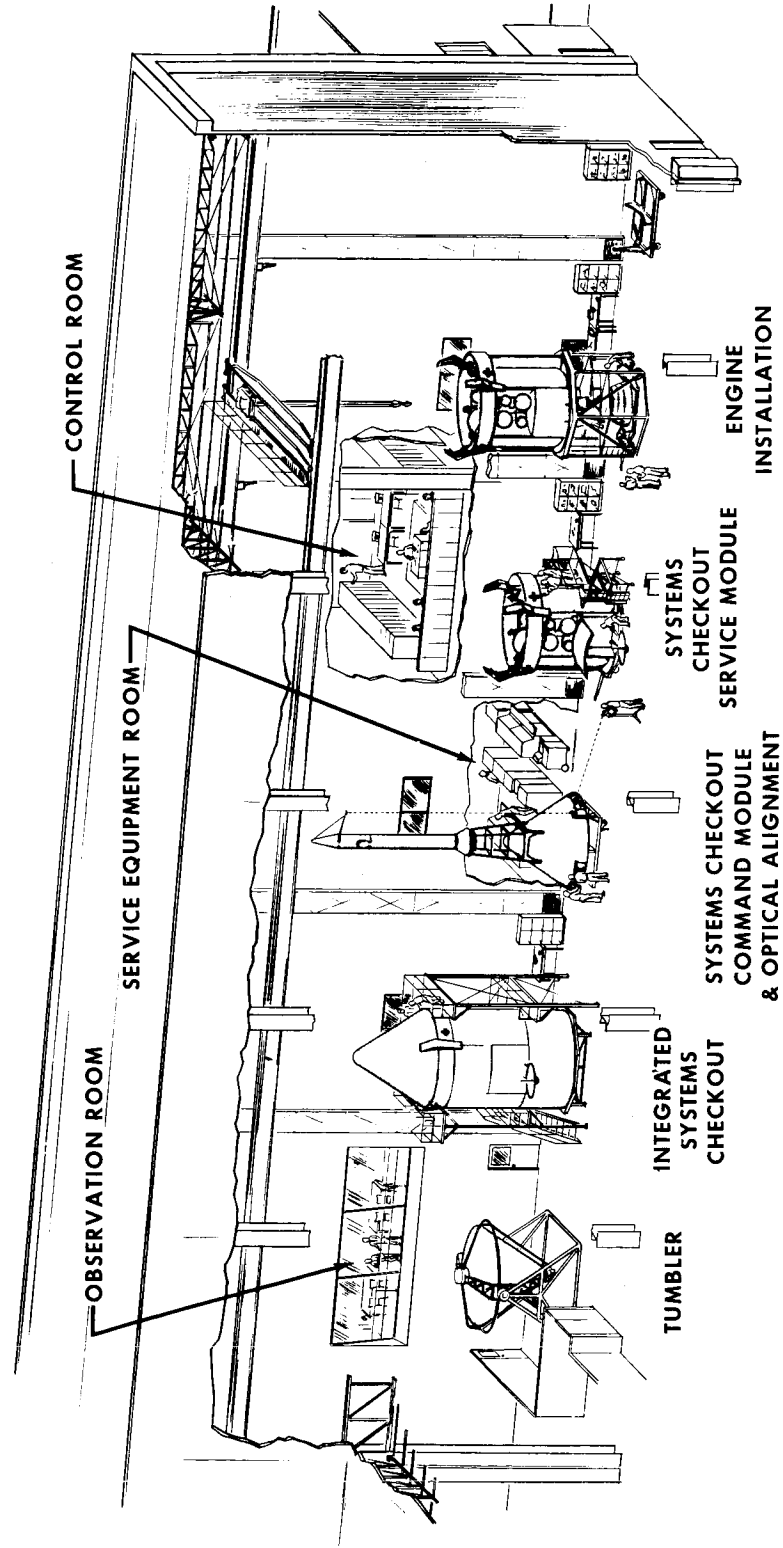
6-62 PS 15030

APOLLO FACILITY PREPARATION SCHEDULE

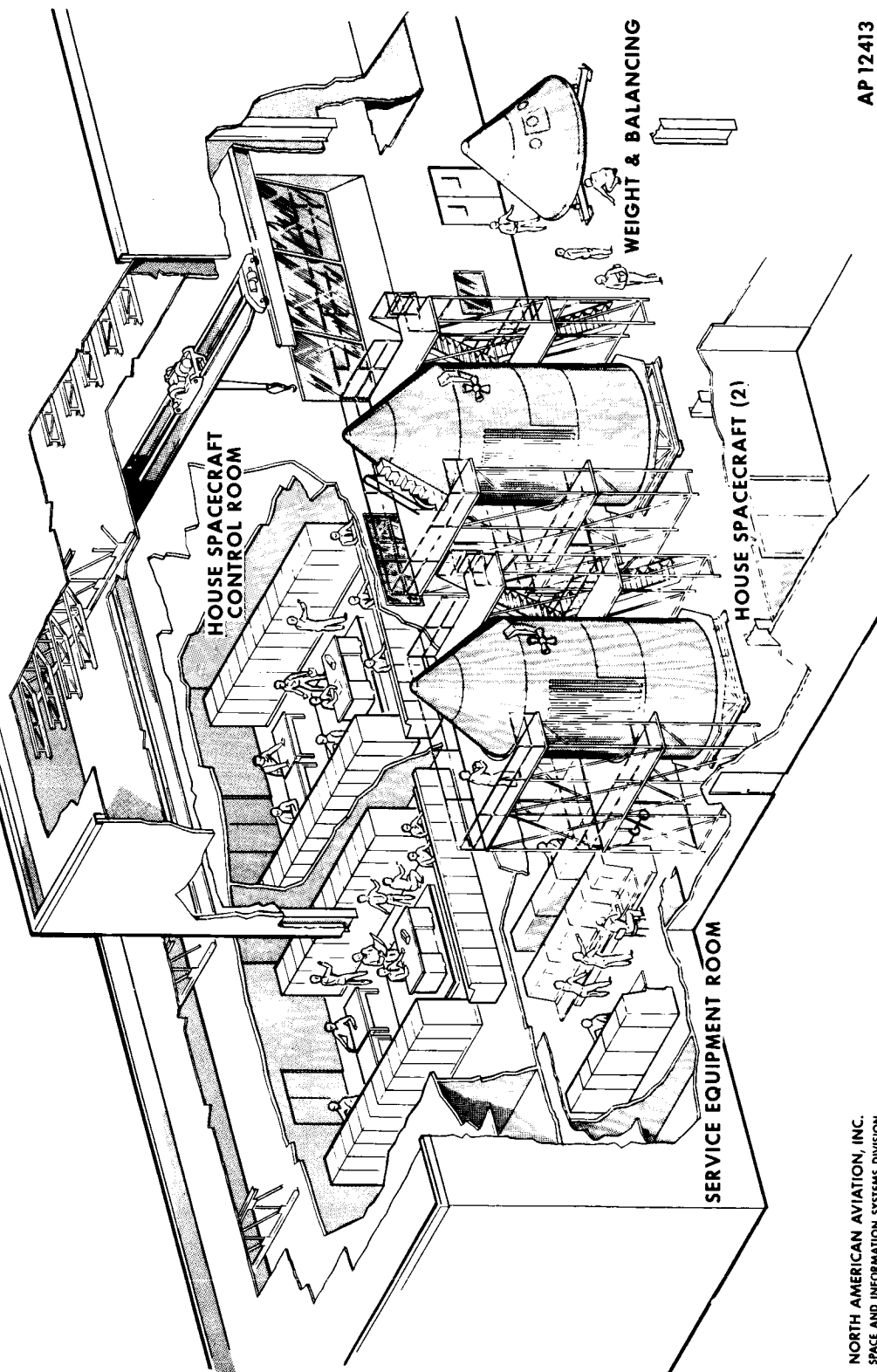
IMPACT TEST FACILITY



APOLLO SYSTEMS INTEGRATION & CHECKOUT FACILITY



APOLLO SYSTEMS INTEGRATION & CHECKOUT FACILITY

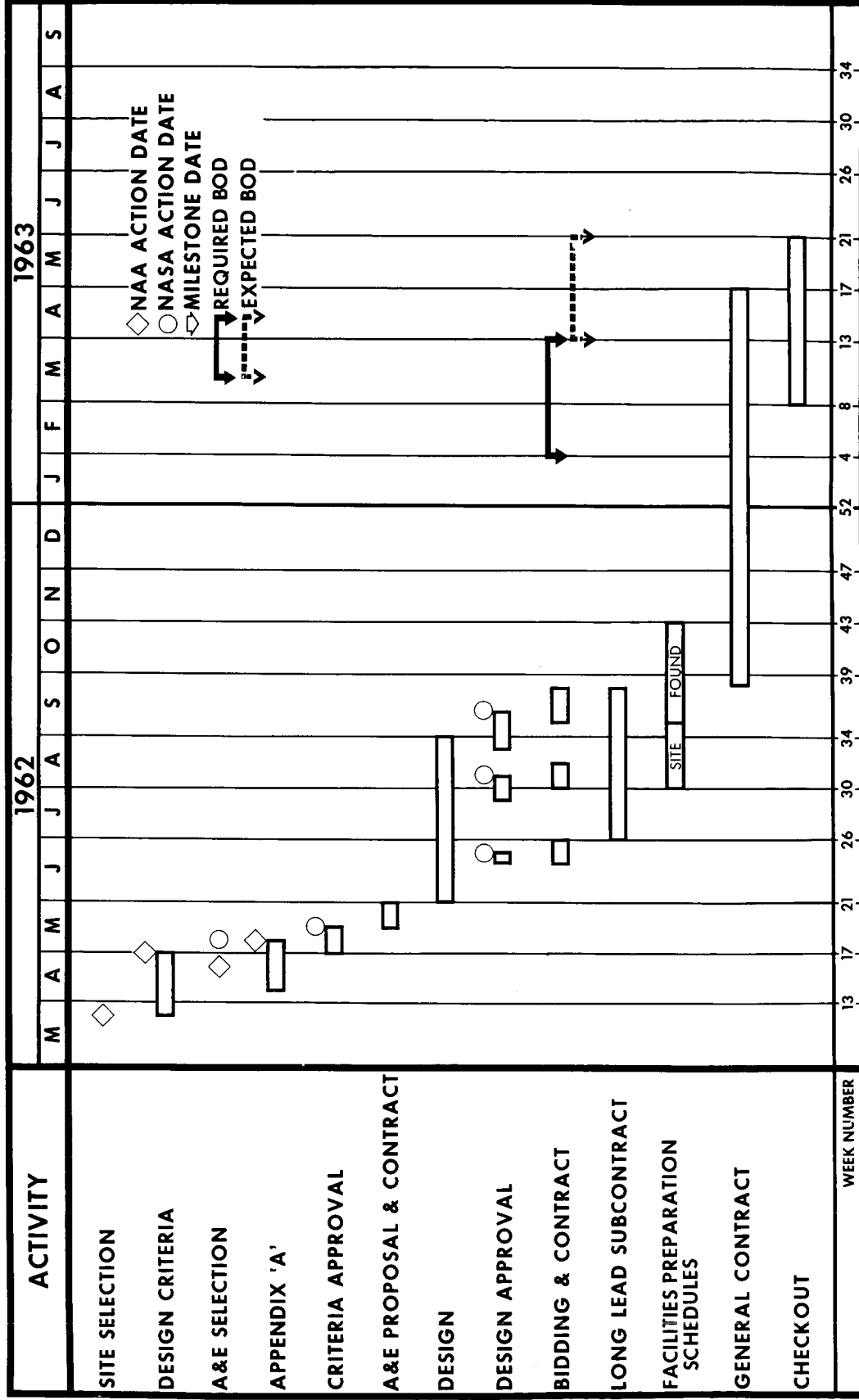


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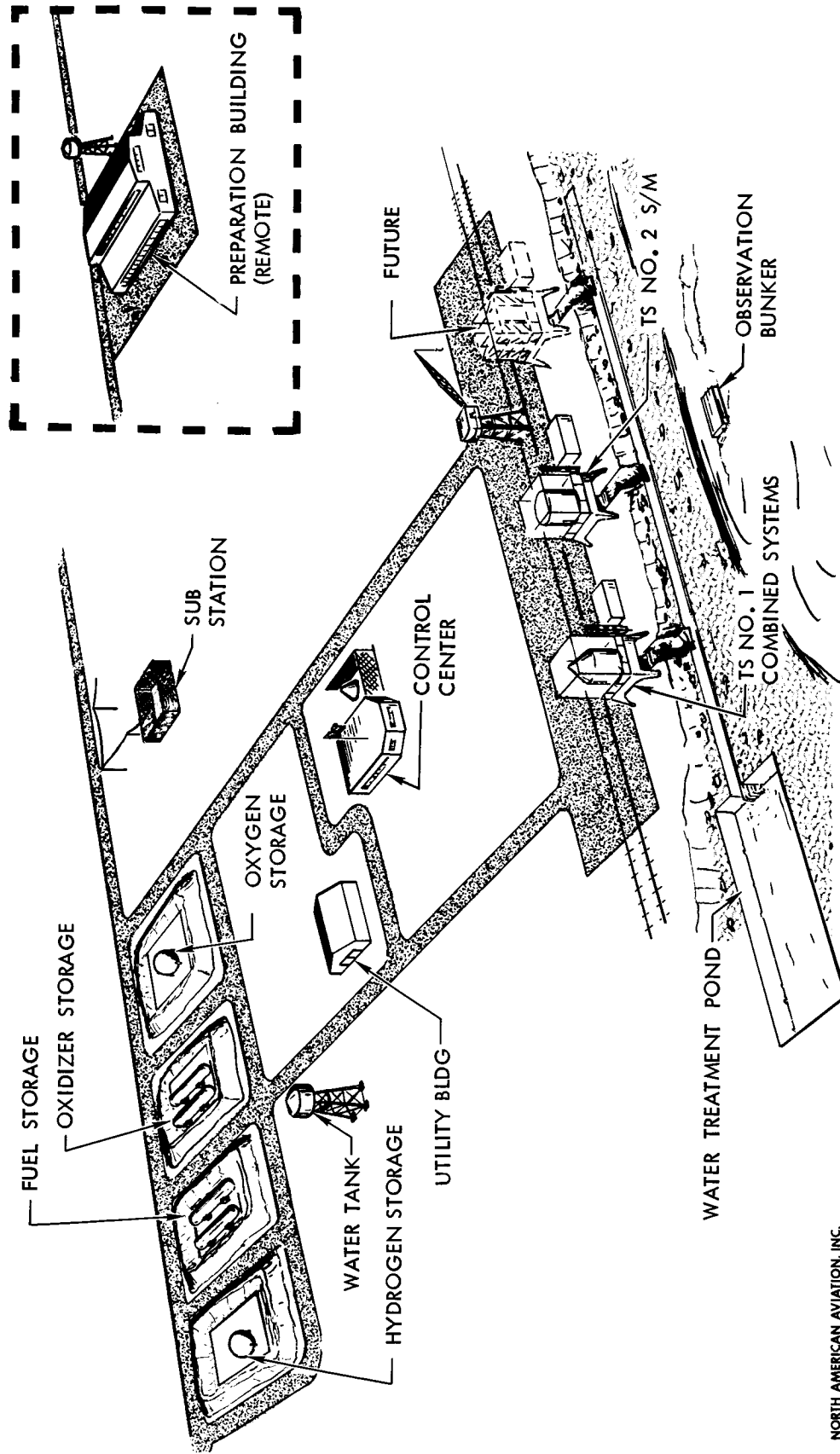
AP 12413

APOLLO FACILITY PREPARATION SCHEDULE

SYSTEMS INTEGRATION & CHECKOUT



PROPULSION SYSTEMS DEVELOPMENT FACILITY

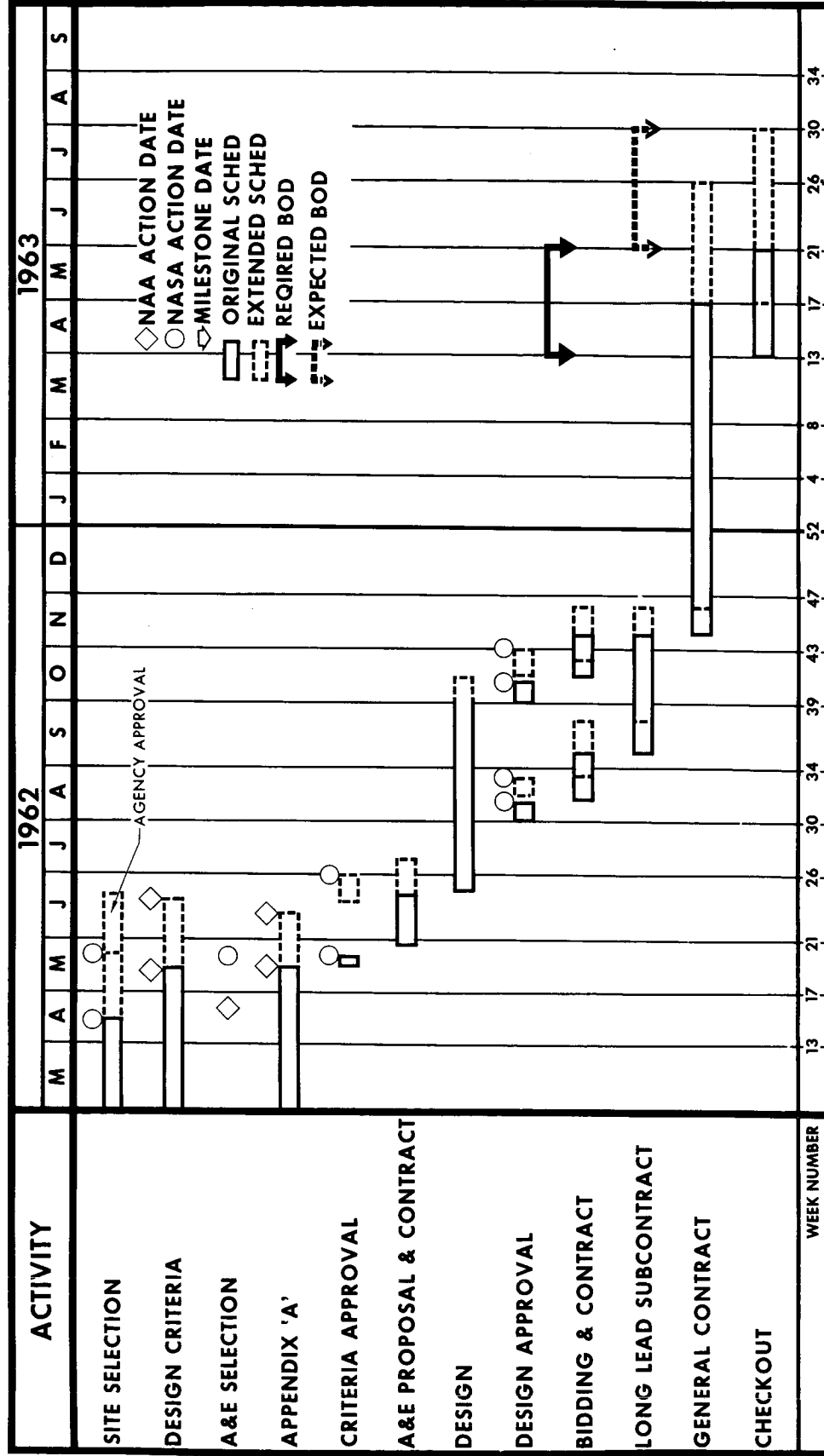


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5-62 AP 14036
SID 62-406

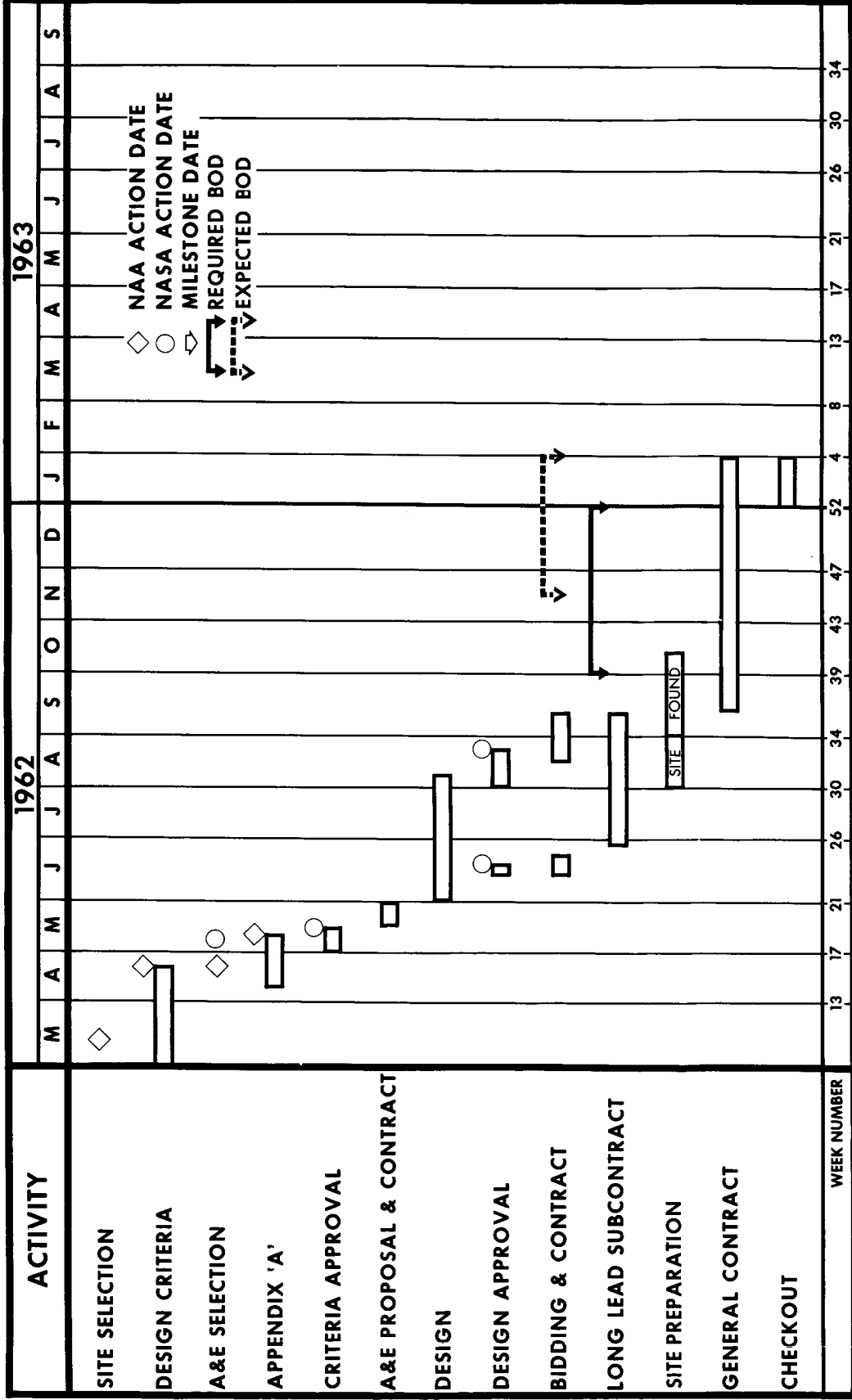
APOLLO FACILITY PREPARATION SCHEDULE

PROPULSION SYSTEMS DEVELOPMENT FACILITY

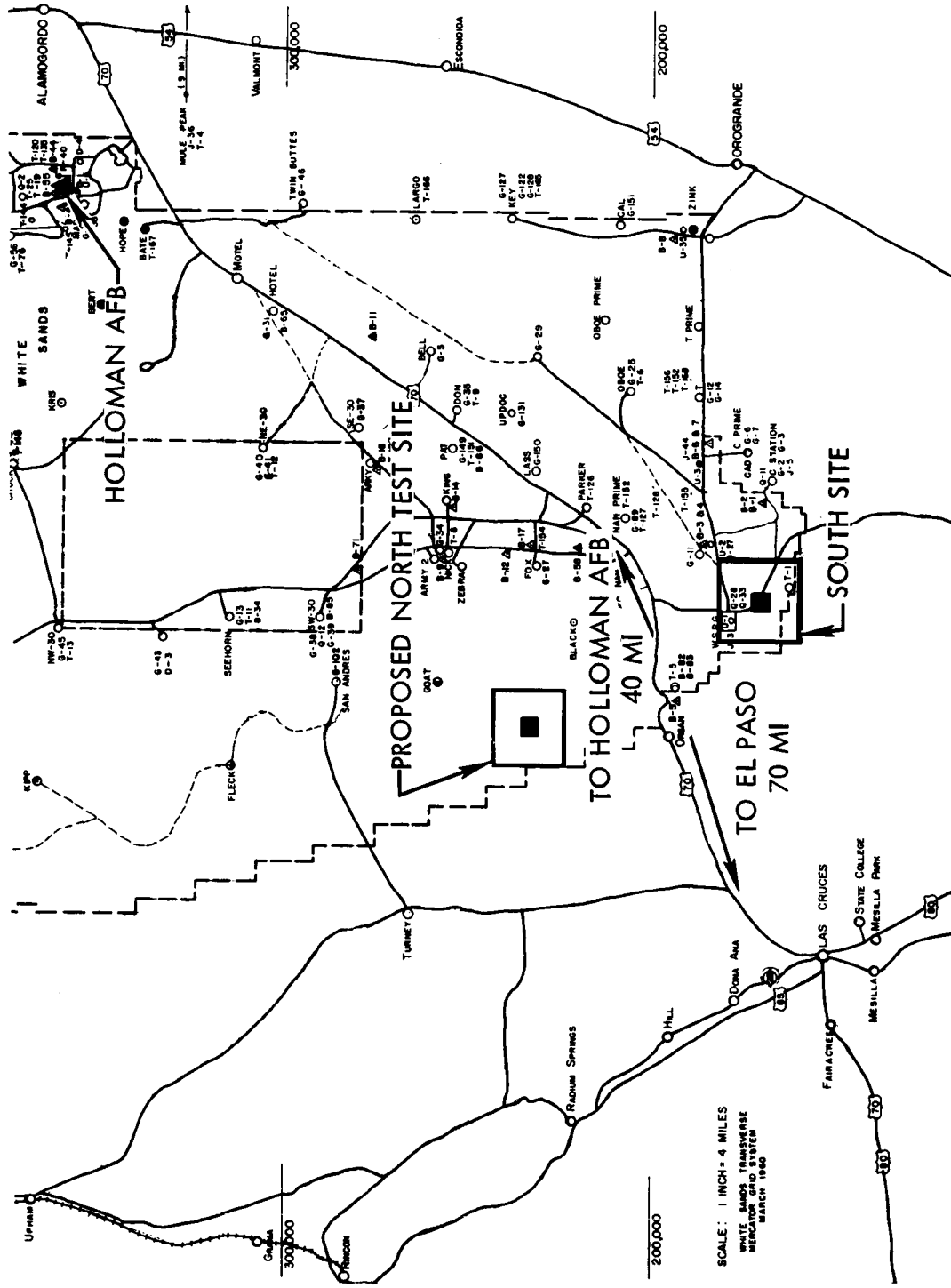


APOLLO FACILITY PREPARATION SCHEDULE

BONDING & TEST



PROPOSED WHITE SANDS TEST SITE



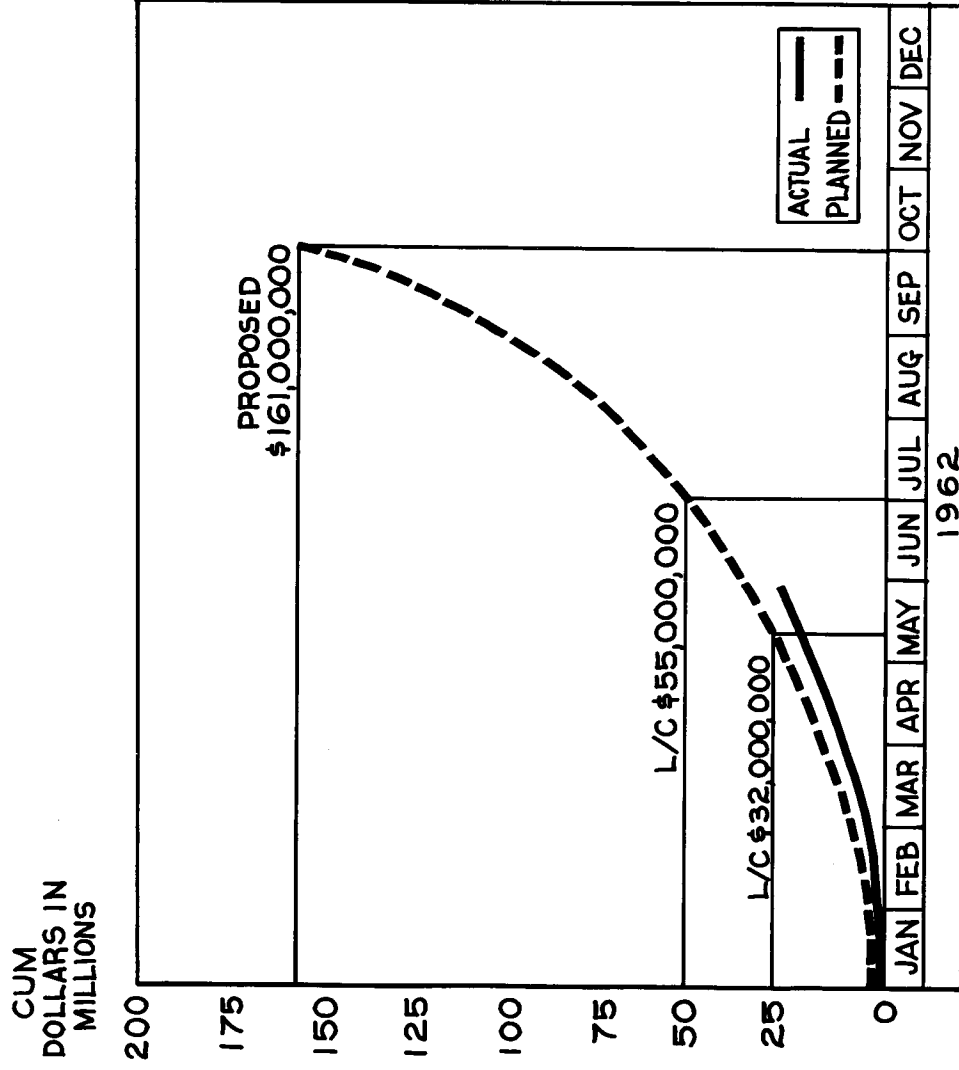
NORTH AMERICAN AVIATION, INC.
SPACE AND INFORMATION SYSTEMS DIVISION

5-62 AP 14032

SID 62-406

14

COST REPORT & PROJECTION



MAJOR EVENTS

• CONTRACT AWARD	28 NOV 61
• LETTER CONTRACT	21 DEC 61
• WIND TUNNEL SCHEDULE DEFINED	11 JAN 62
• NASA OFFICE AT NAA	14 JAN 62
• REORGANIZATION OF SUBDIVISION	15 JAN 62
• C/M BASIC LINES	17 JAN 62
• S/M BASIC LINES	18 JAN 62
• PRELIMINARY MAKE OR BUY LIST	19 JAN 62
• NASA/NAA PLANNING DOCUMENT DELIVERY	2 FEB 62
• MFG STUDIES --ADV PRODUCTION METHODS COST REDUCTION	19 FEB 62

MAJOR EVENTS (CONT)

• PRELIMINARY LES DESIGN	19 FEB 62
• PRELIMINARY MASTER MEASUREMENTS	19 FEB 62
• MICROMETEOROID IMPACT STUDY	20 FEB 62
• S/C PERFORMANCE SPECIFICATION	28 FEB 62
• C/M STRUCTURE CONFIGURATION	1 MAR 62
• S/M STRUCTURE CONFIGURATION	1 MAR 62
THERMO WIND TUNNEL TEST REPORT	1 MAR 62
INITIAL DESIGN CRITERIA SPEC	1 MAR 62
NAA HOUSTON OFFICE ESTABLISHED	1 MAR 62

MAJOR EVENTS (CONT)

- INITIAL RELEASE OF PROGRAM PLAN 1 MAR 62
- S/M B GO-AHEAD 30MAR 62
- PRELIMINARY WEIGHT & BALANCE REPORT 1 APR 62
- C/M AERODYNAMIC FREEZE 1 APR 62
- PRELIMINARY AERO DATA & LOADS REPORTS 1 APR 62
- INITIAL DRAWING LISTS 1 APR 62
- LITTLE JOE II PLAN 3 APR 62
- CABIN INTERIOR & CREW STATION ARRANGEMENT 15 APR 62

MAJOR EVENTS (CONT)

- APPROVAL OF PROGRAM SCHEDULE 26 APR 62
- PRELIMINARY LUNAR LANDING
TRAJECTORY ANALYSIS 1 MAY 62
- FIRST SIMULATION WITH SEMI-HARD
MOCK-UP 1 MAY 62
- ALLOWABLE RADIATION DOSAGE TABLE 1 MAY 62
- NASA/NAA B/P NO. 6 INSTRUMENTATION
LIST 1 MAY 62
- INITIAL S/C SUBSYSTEMS SPECS 1 MAY 62
- INITIAL FLIGHT CREW PERFORMANCE SPECS 1 MAY 62
- INITIAL TRAINING EQUIPMENT SPECS 1 MAY 62

MAJOR EVENTS (CON'T)

- INITIAL MAINTENANCE PLAN 1 MAY 62
- COMMUNICATIONS PERFORMANCE 1 MAY 62
 & INTERFACE SPECS
- S/M MOCK-UP DESIGN 15 MAY 62

MAJOR FUTURE EVENTS

(11 JUNE — 11 SEPT)

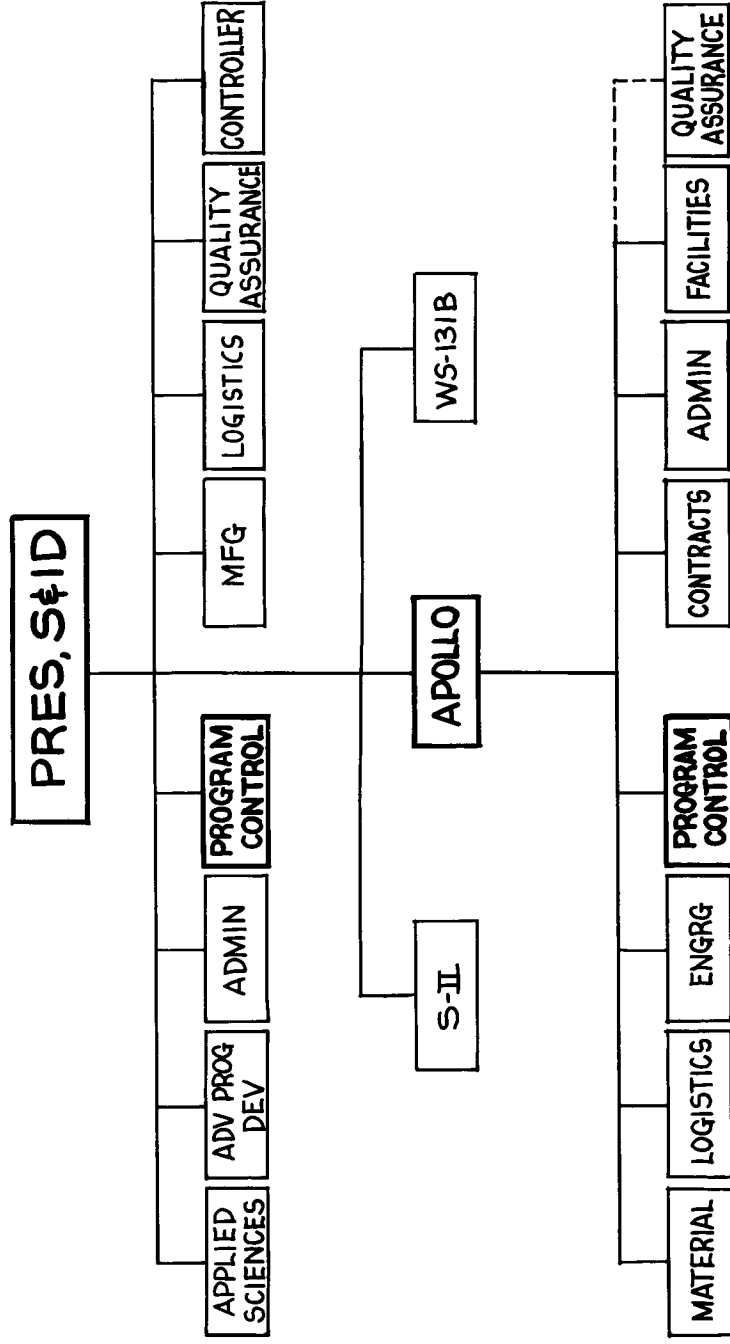
- SEMI-HARD MOCK-UPS COMPLETE
- CABIN INTERIOR MOCK-UPS COMPLETE
- HEAT SHIELD MATERIAL SELECTION
- S/M ENGINE CONTROL REQUIREMENT DEFINED
- 100% B/P DESIGN RELEASE
- 1ST QUALIFICATION STATUS LIST
- 1ST FAILURE REPORT SUMMARY
- INITIAL SYSTEM ANALYSIS COMPLETE

MAJOR FUTURE EVENTS (CONT)

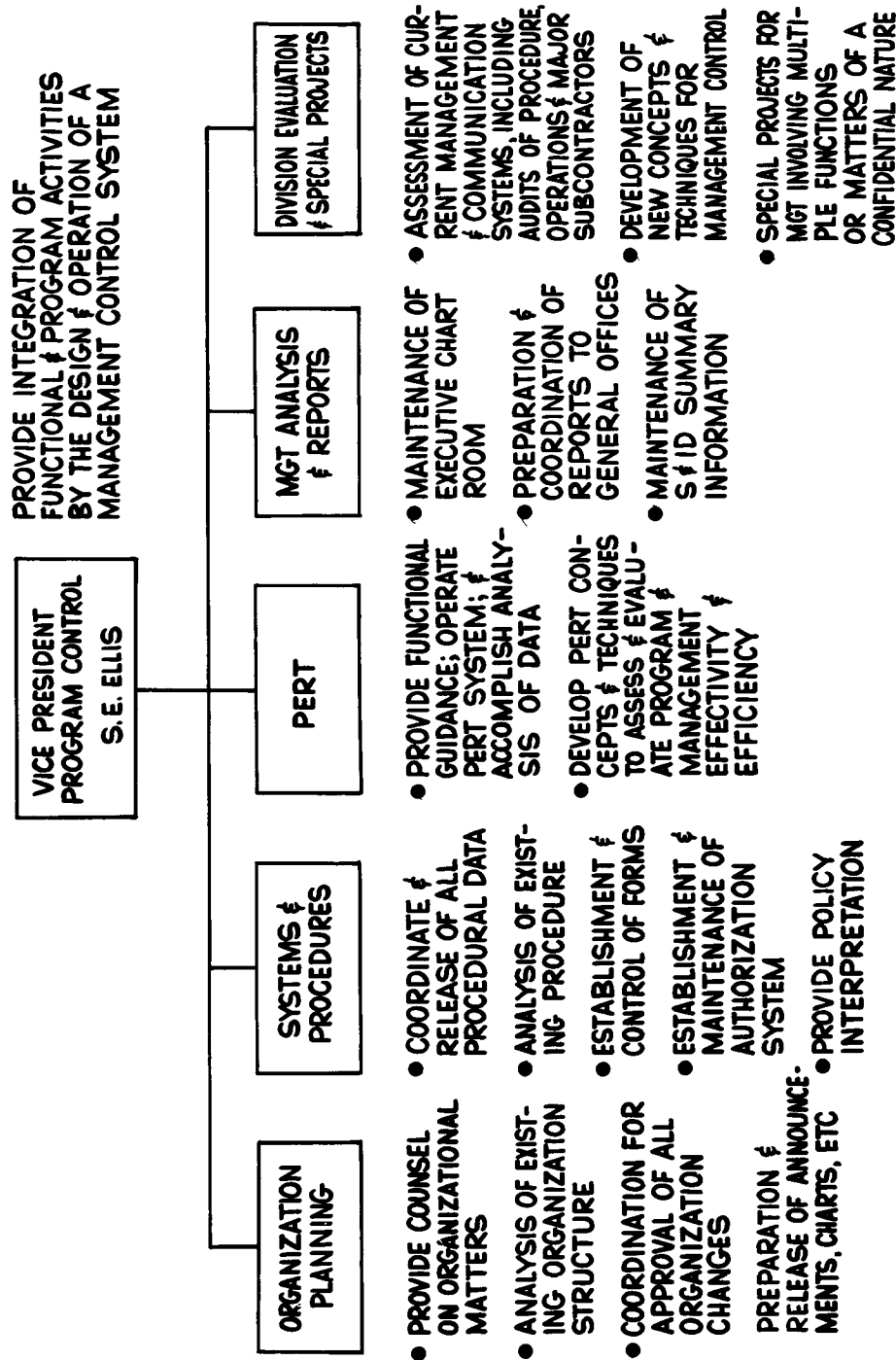
(11 JUNE — 11 SEPT)

- **MOCK-UP NO.3 TO NASA**
- **S/M-ADAPTER INTERFACE, MOCK-UP NO.4**
- **CABIN EXTERIOR EQUIPMENT, MOCK-UP NO.5**
- **COMPLETE S/M, MOCK-UP NO.7**
- **AIRLOCK & DOCKING, MOCK-UP NO.8**
- **LAND & WATER IMPACT, B-1**
- **LAND & WATER IMPACT TEST**
- **PROTOTYPE STABILIZATION & CONTROL
SYSTEM DEFINED**

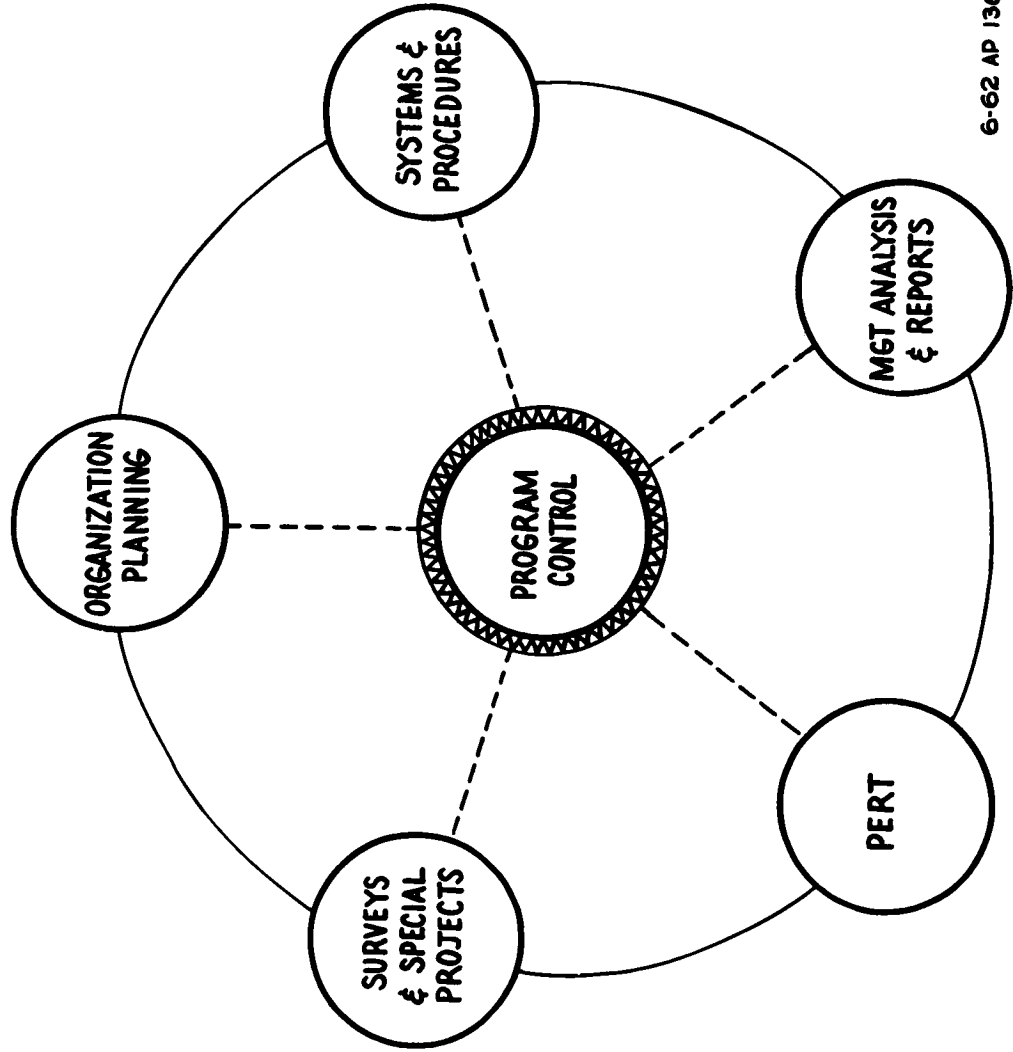
PROGRAM CONTROL



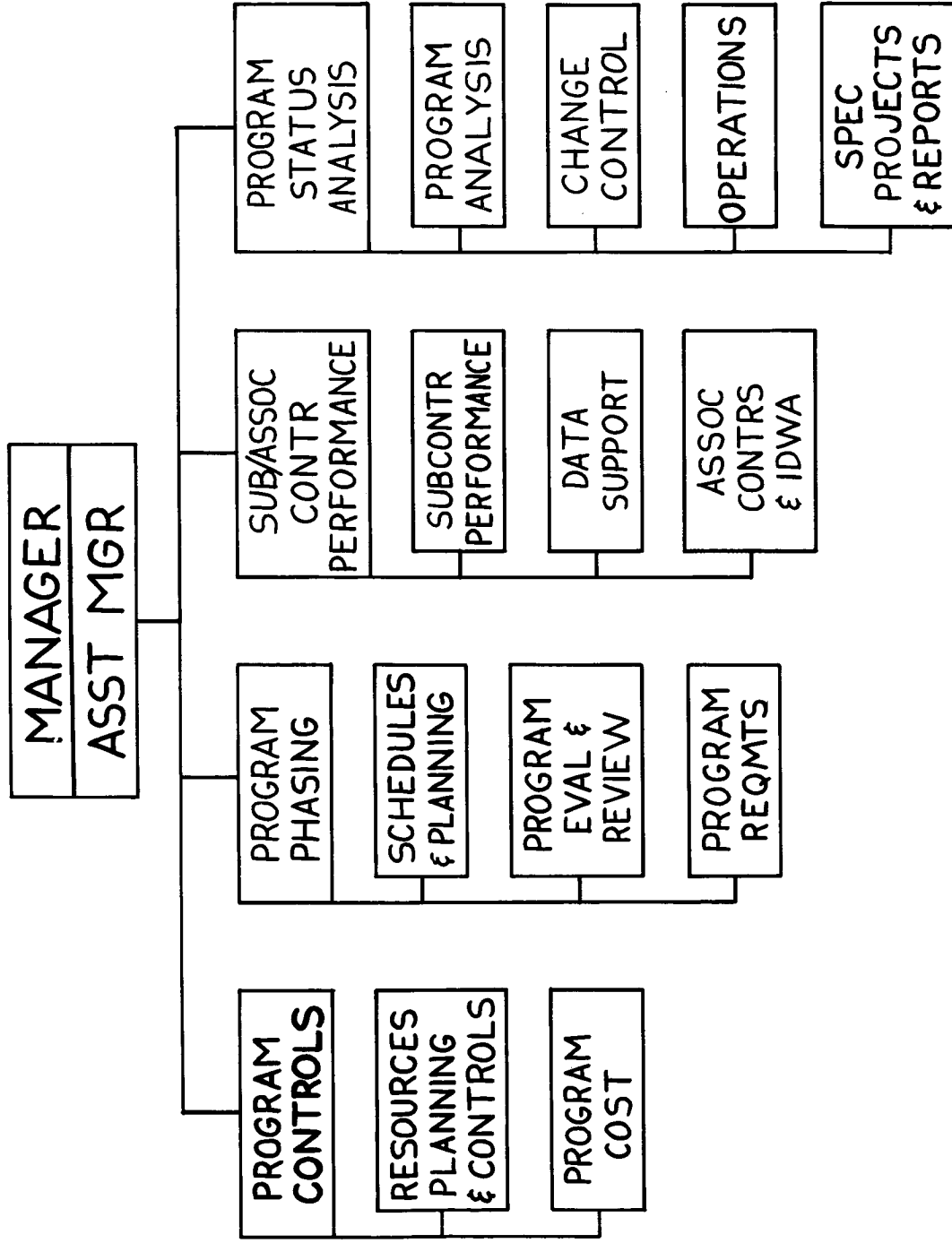
S&ID PROGRAM CONTROL



DIVISION PROGRAM CONTROL



APOLLO PROGRAM CONTROL



PROGRAM CONTROL FUNCTIONS

- PROGRAM SCHEDULING & PHASING
- PERT OPERATIONS
- DEVELOPMENT PLANNING
- RESOURCES PLANNING
- COST ANALYSIS
- PROGRAM STATUS ANALYSIS
- CHANGE CONTROL
- OPERATION RESEARCH
- CONTROL ROOM
- PROGRAM PROGRESS REPORTS

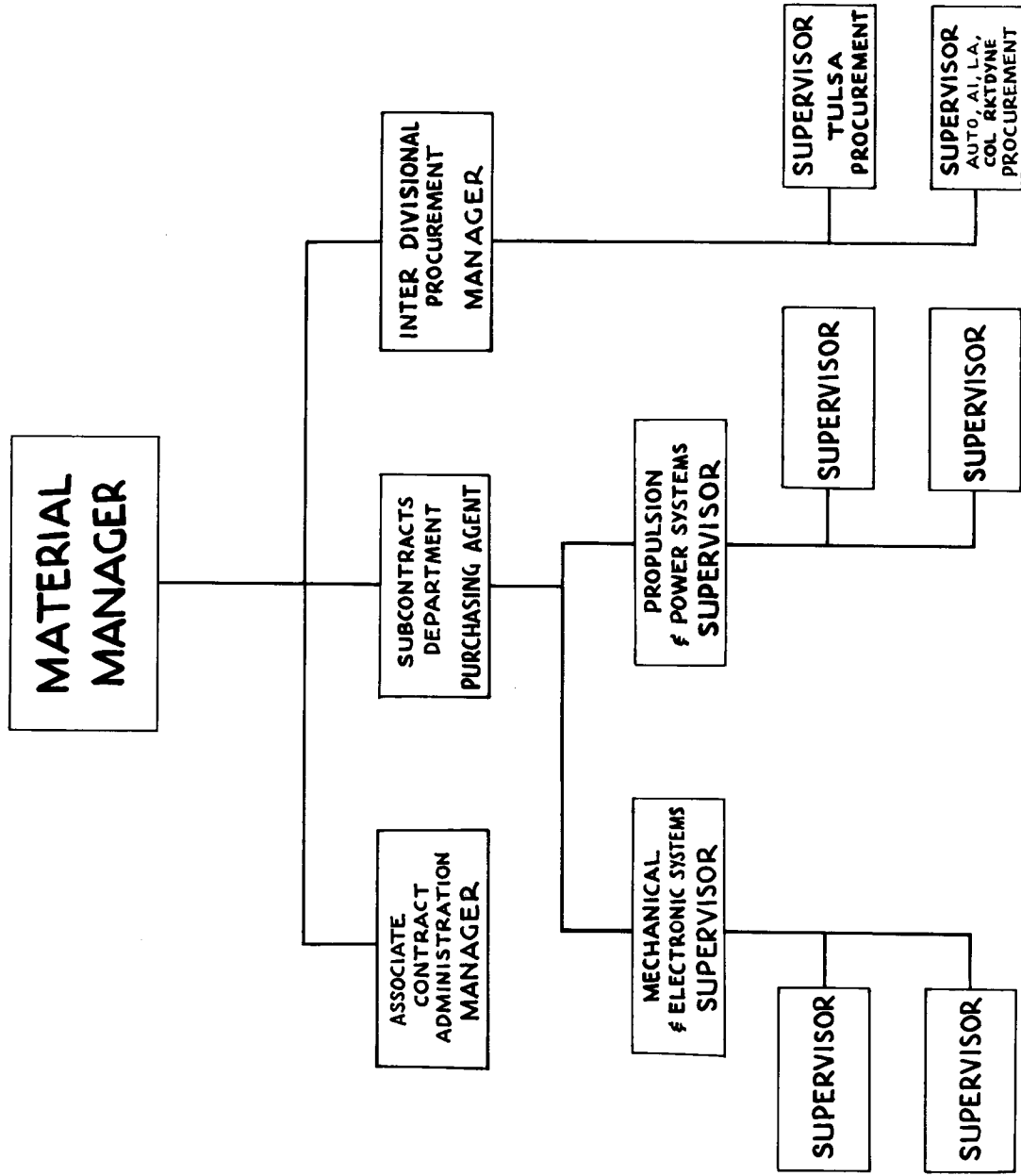
PROGRAM CONTROL ACTIVITY

- PERT OPERATIONS & COORDINATION
- PERT/COST STUDY INITIATED
- INITIAL PROGRAM PLAN SUBMITTED
- MONTHLY PROGRESS REPORT
- FIRST QUARTERLY PROGRESS REPORT
- CONTROL ROOM CONCEPT ESTABLISHED & IN WORK
- NASA/S&ID CONTROL ROOM INTERFACE IN WORK
- NASA/S&ID SCHEDULE INTERFACE-DEVELOPMENT PLAN
- SUBCONTRACTOR INTERFACE ESTABLISHED
- PROGRAM VISIBILITY MGMT REPORTS ESTABLISHED

APOLLO MATERIAL DEPARTMENT

QUARTERLY PROGRESS REPORT

JUNE 1962



SIGNIFICANT ACCOMPLISHMENTS

- DEPARTMENTAL
- PROCEDURAL
- SUBCONTRACTOR
- CONTROLS

SIGNIFICANT ACCOMPLISHMENTS

DEPARTMENTAL

- **TASK ASSIGNMENTS**

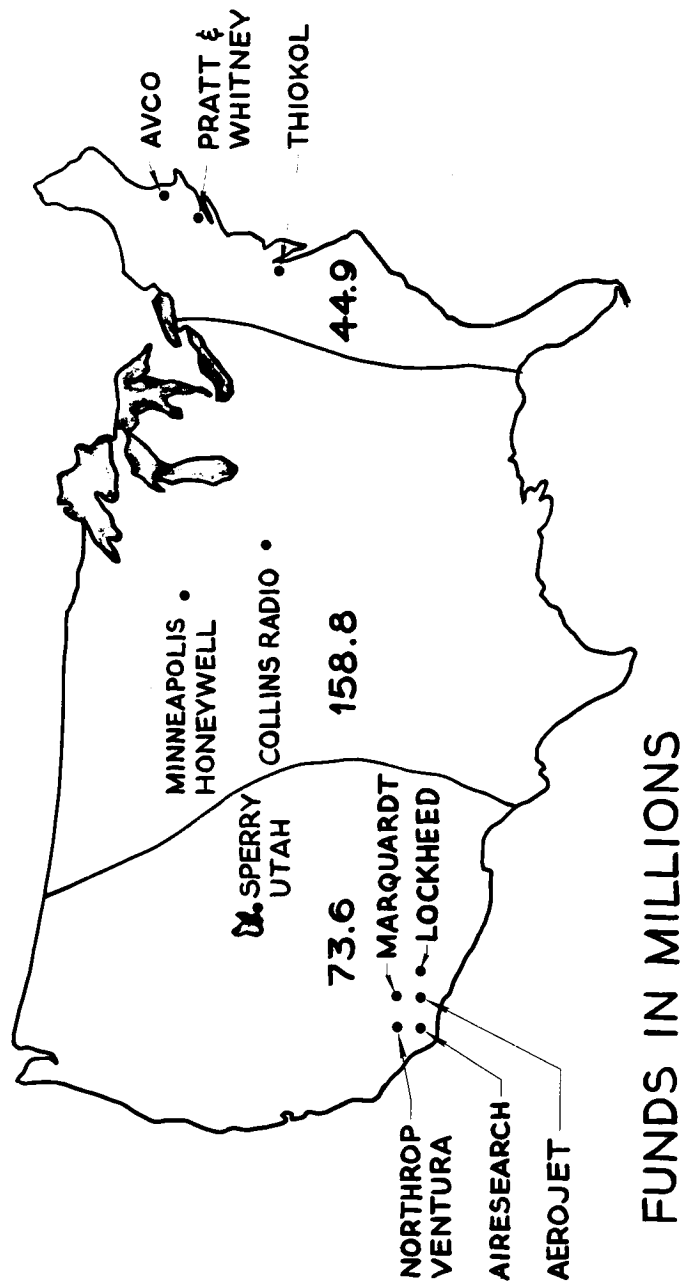
- **ORGANIZATION**

- **TRAINING PROGRAM**

SIGNIFICANT ACCOMPLISHMENTS PROCEDURAL

- NEGOTIATION PLAN
- COMMUNICATION PRACTICE
- SUPPLIER VISITATION PROCEDURE
- COORDINATION MEETINGS

APOLLO SUBCONTRACTS



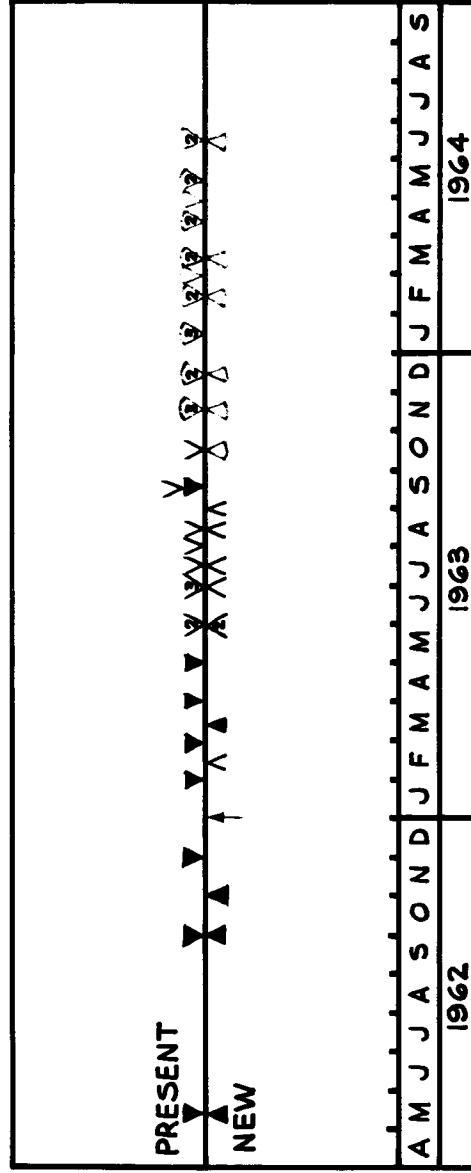
DOLLARS COMMITTED

SUBCONTRACTOR	LIMIT OF LIABILITY (MILLIONS)	EXPENDITURES PLUS COMMITMENTS		
		30 MAY 62	30 JUN 62*	30 SEP 62*
COLLINS RADIO	3.08	1.52	6.25	16.00
LOCKHEED	0.98	0.43	1.42	2.03
MINNEAPOLIS-HONEY	5.33	3.00	6.25	16.25
PRATT & WHITNEY	3.61	1.50	4.10	7.60
NORTHROP VENTURA	1.00	0.44	1.41	2.85
AIRESEARCH	2.50	1.22	4.00	6.20
AVCO	1.00	0.67	2.76	6.60
AEROJET	1.44	0.38	1.55	4.75
MARQUARDT	2.00	0.83	3.50	6.10
THIokol	0.63	0.32	0.88	1.05
MISC		0.30	1.72	6.53
TOTALS	20.57	10.61	33.84	75.96

* ESTIMATED

SERVICE MODULE PROPULSION SYSTEM

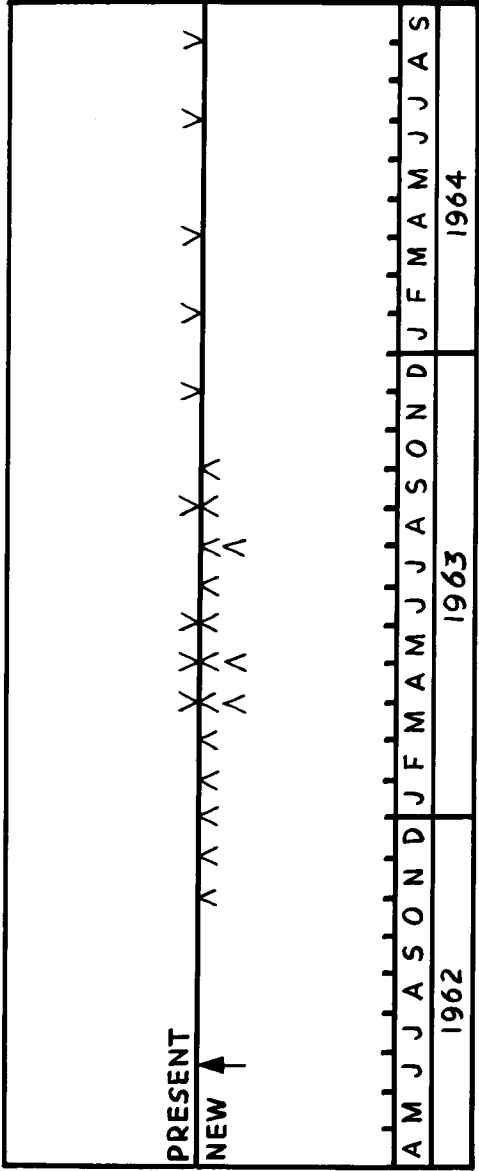
AEROJET



▲ DESIGN ENGRG COMPLETE
 ■ MOCKUP
 ▼ PREQUALIFICATION
 ◆ QUALIFIED

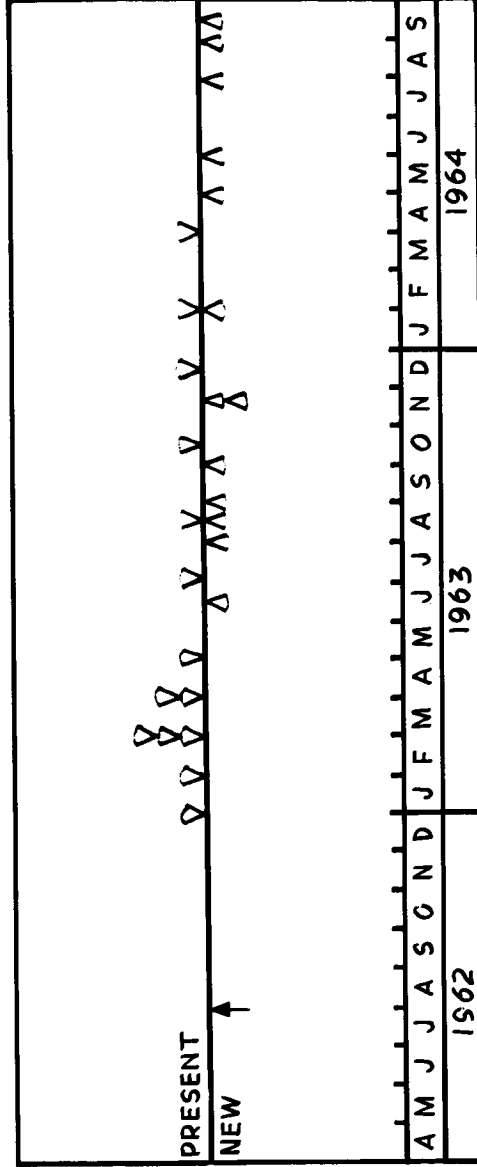
ENVIRONMENTAL CONTROL SYSTEM

AIRESEARCH



HEAT SHIELD

AVCO



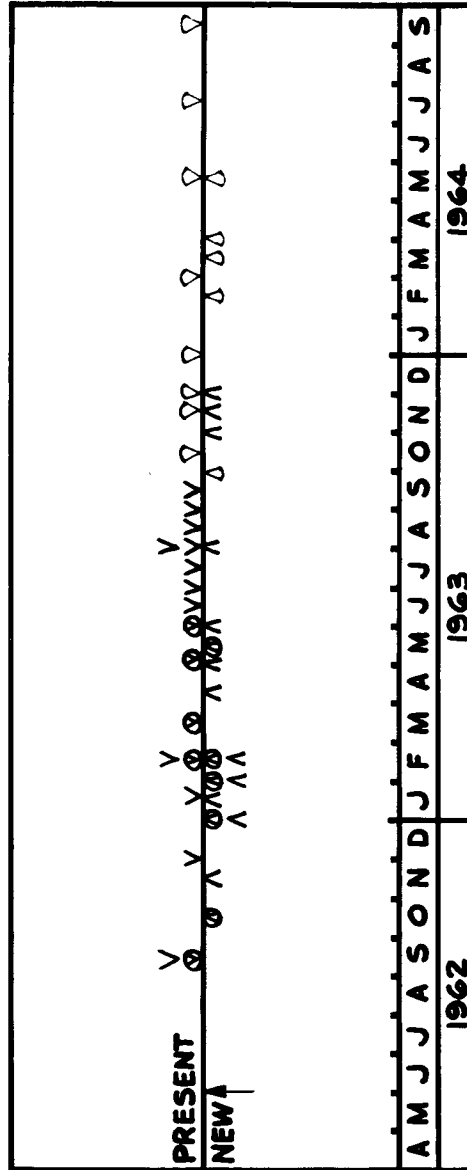
↑ DESIGN ENGRG COMPLETE
△ QUALIFIED

TELECOMMUNICATION SYSTEM
COLLINS RADIO

[illegible]

**DESIGN ENGRG COMPLETE
PREQUALIFICATION
QUALIFIED**

LAUNCH ESCAPE MOTOR LOCKHEED



A DESIGN ENGRG COMPLETE
 A PREQUALIFICATION
 O INERT MOTORS
 Δ QUALIFIED

REACTION CONTROL SYSTEM

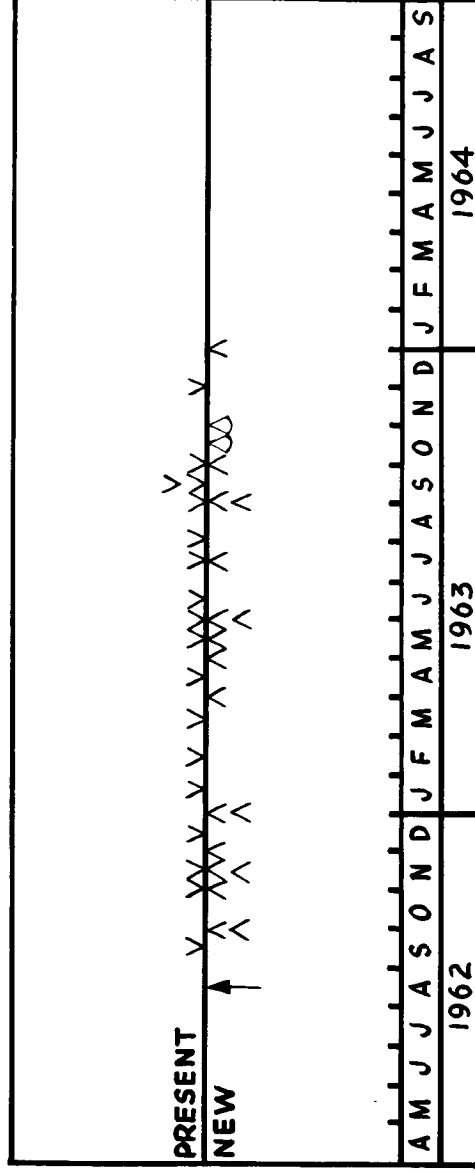
MARQUARDT

PRESENT	NEW	COMMAND MODULE REACTION CONTROL JETS
		AM J J A S O N D J F M A M J J A S 1962 1963 1964

↑ DESIGN ENGRG COMPLETE
 ▲ MOCKUP
 ∨ PREQUALIFICATION
 △ QUALIFIED

STABILIZATION & CONTROL SYSTEM

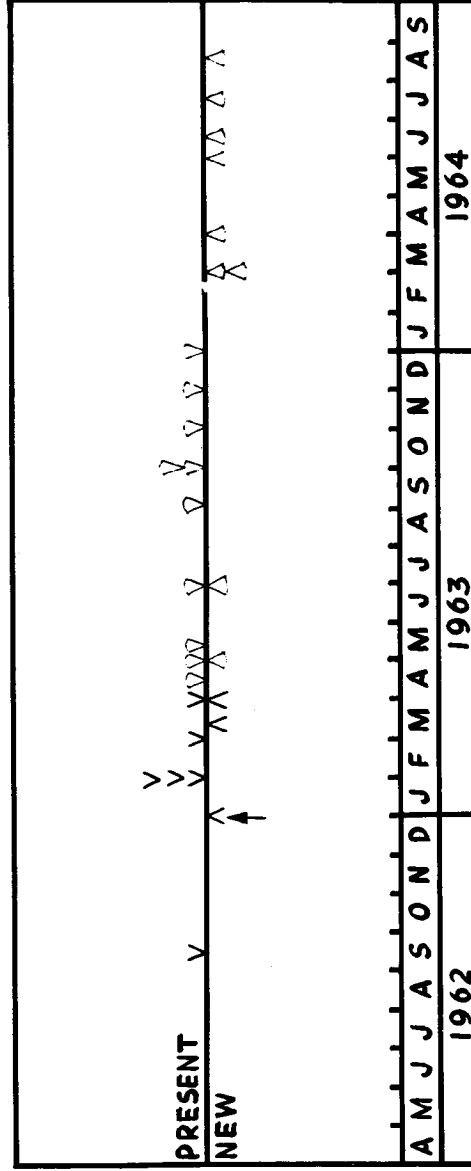
MINNEAPOLIS-HONEYWELL



↑ DESIGN ENGRG COMPLETE
 ^ PREQUALIFICATION
 ^ QUALIFIED

EARTH LANDING SYSTEM

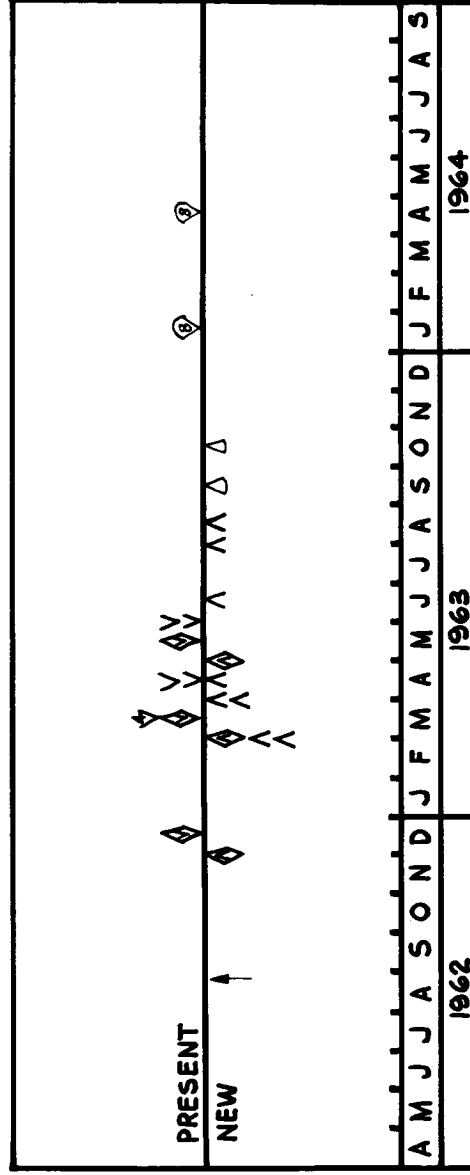
NORTHROP VENTURA



A DESIGN ENGRG COMPLETE
 V PREQUALIFICATION
 X QUALIFIED

FUEL CELL

PRATT & WHITNEY



↑ DESIGN ENGRG COMPLETE
 ◆ BREADBOARD
 ^ PREQUALIFICATION
 ^ QUALIFIED

ESCAPE TOWER JETTISON MOTOR THIOKOL

[illegible]

↑ DESIGN ENRG COMPLETE
Λ PREQUALIFICATION
⊕ INERT MOTORS
Λ QUALIFIED

CONTROLS

SUBCONTRACTOR PROGRAMS CONTROLLED THROUGH:

- SUBCONTRACTOR BRIEFING SESSIONS
- RESIDENT REPRESENTATION
- REQUIRED REPORTS (INCLUDING PERT)
- PERIODIC SUBCONTRACTOR
COORDINATION MEETINGS

ITEMS REQUIRING SOURCE SELECTION

TO SOURCE SELECTION BOARD

ITEM

BATTERY

9 JUL 62

INVERTER

2 JUL 62

TELESCOPE

17 SEP 62

SUPERCritical GAS
STORAGE SYSTEM

18 JUN 62

PROPELLANT UTILIZATION
SYSTEM

15 AUG 62

RENDEZVOUS RADAR &
ALTIMETER

*

MASTER TIMING
SYSTEM (CLOCK)

10 AUG 62

*TO BE SCHEDULED
DEPENDENT UPON
RELEASE DATE

FORECAST OF ACCOMPLISHMENTS

- DEFINITIVE CONTRACTS BY 30 AUG 62
- RESIDENT REPRESENTATION BY 30 JUL 62
- COST MANAGEMENT
- COST REDUCTION PROGRAMS
- SUBCONTRACTOR BRIEFINGS CONTINUED
INCREASED COST CONTROL & PERT
INSTRUCTIONS TO SUBCONTRACTOR MGMT
- CONTINUED FACILITY SURVEYS

• **SPACECRAFT
STRUCTURAL DESIGN
PROJECT INTEGRATION
&
RELIABILITY**

6-62 AP 13723

STRUCTURES ACCOMPLISHMENTS

- CONFIGURATION DEFINED
- DESIGN CONCEPT ESTABLISHED
- TEST REQUIREMENTS ESTABLISHED
- STRUCTURAL COMPONENT TEST DRAWINGS COMPLETE
- LAUNCH ESCAPE SYSTEM STRUCTURE RELEASE
- BOILERPLATE DESIGN RELEASE
- MOCKUPS

PROJECT INTEGRATION MILESTONES

- APOLLO INTERFERENCE CONTROL PLAN RELEASED
- MSC-MSFC-S&ID LAUNCH VEHICLE COORDINATION PANELS ESTABLISHED
- MOCKUP-BOILERPLATE - SPACECRAFT UTILIZATION & CONFIGURATION FIRMED UP WITH NASA
- PRELIMINARY TECHNICAL DEVELOPMENT PLAN FOR S/M BAKER
- TEST PLAN REVISED

RELIABILITY STATUS

RELIABILITY PROGRAM PLAN

QUALIFICATION-RELIABILITY TEST PLAN

RELIABILITY-SAFETY CRITERIA

QUARTERLY PROGRESS REPORT

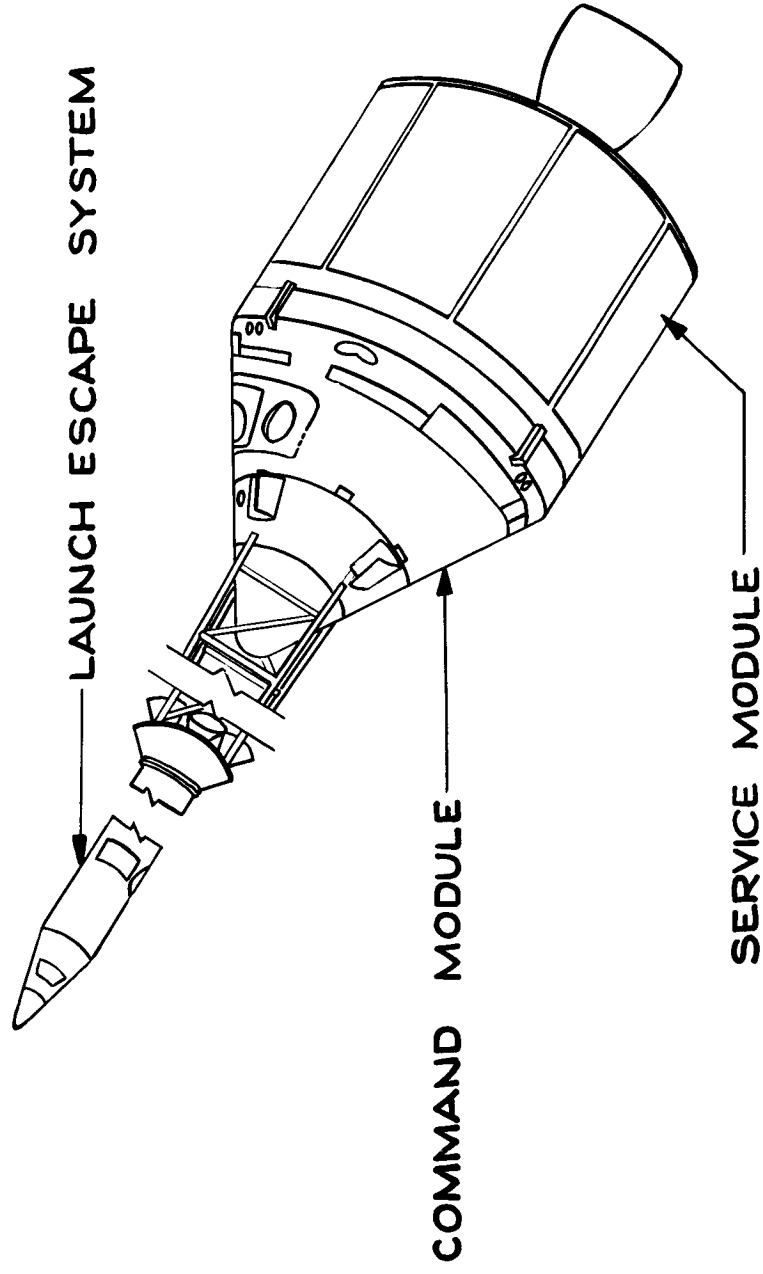
SUBMITTED 40 RELIABILITY SPECS INPUTS

REVIEWED 12 SUBCONTRACTOR RELIABILITY
PLANS

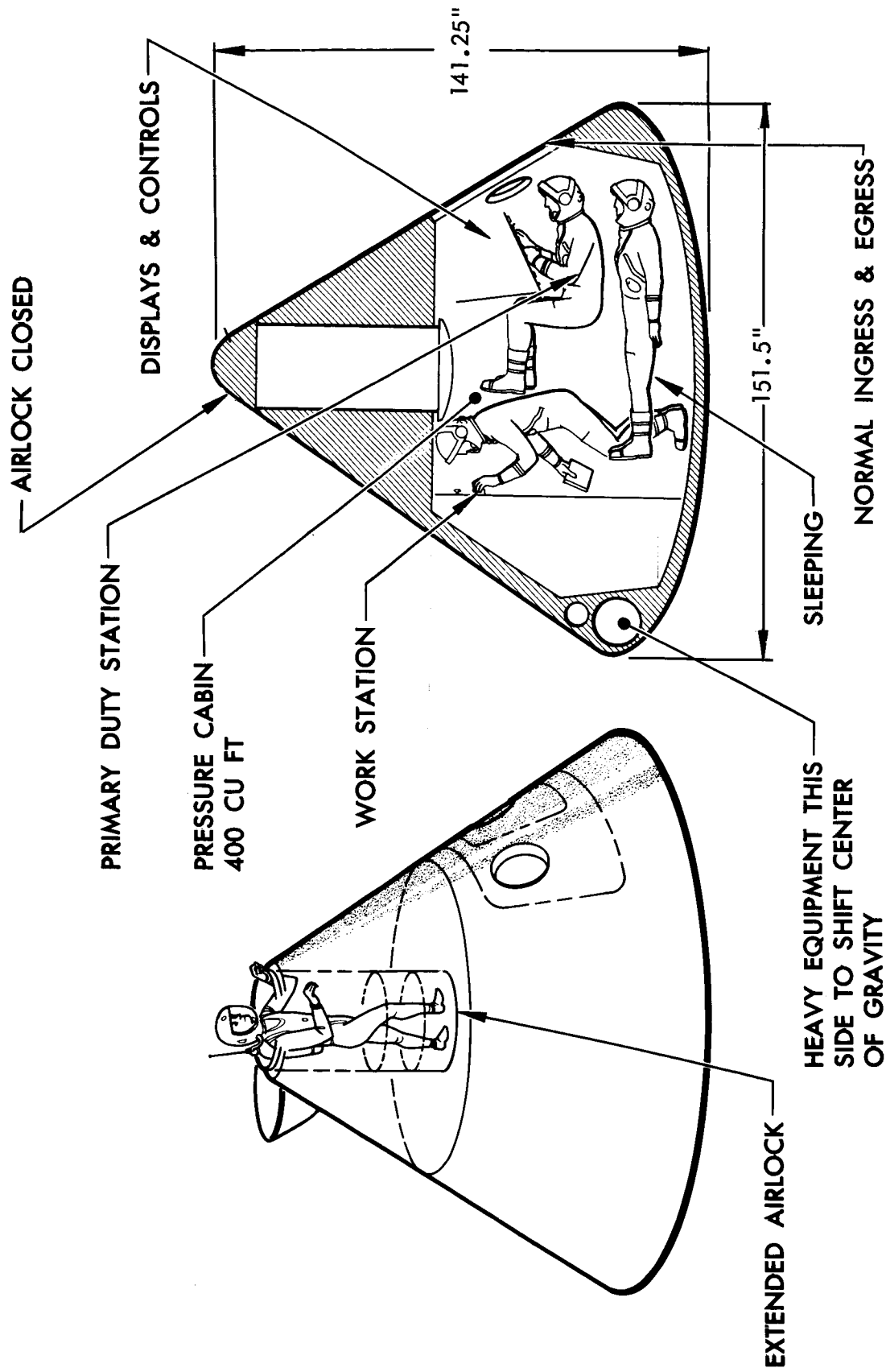
REVIEWED 15 SUBCONTRACTOR TEST PLANS

6-62 AP 13726

APOLLO SPACECRAFT



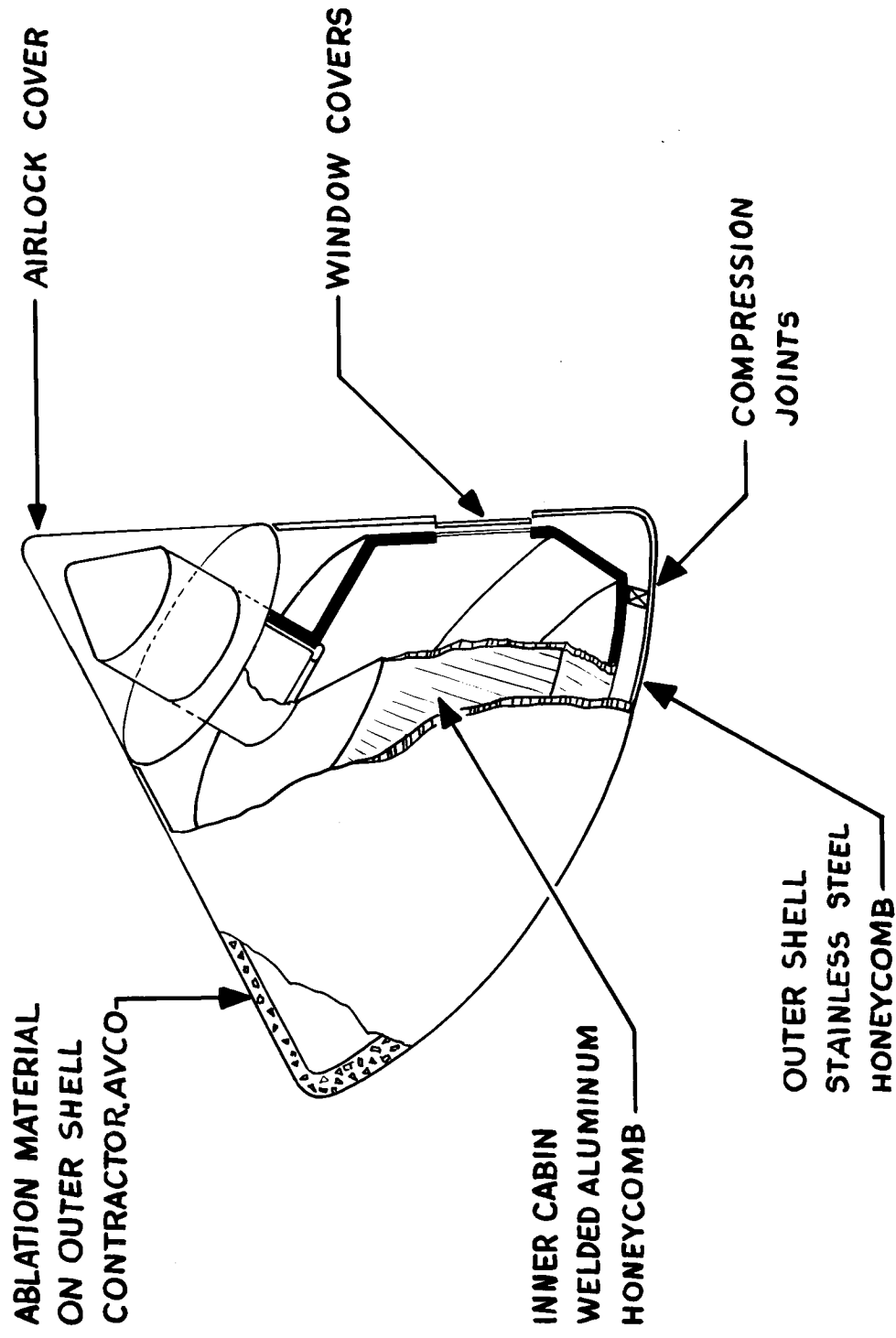
COMMAND MODULE



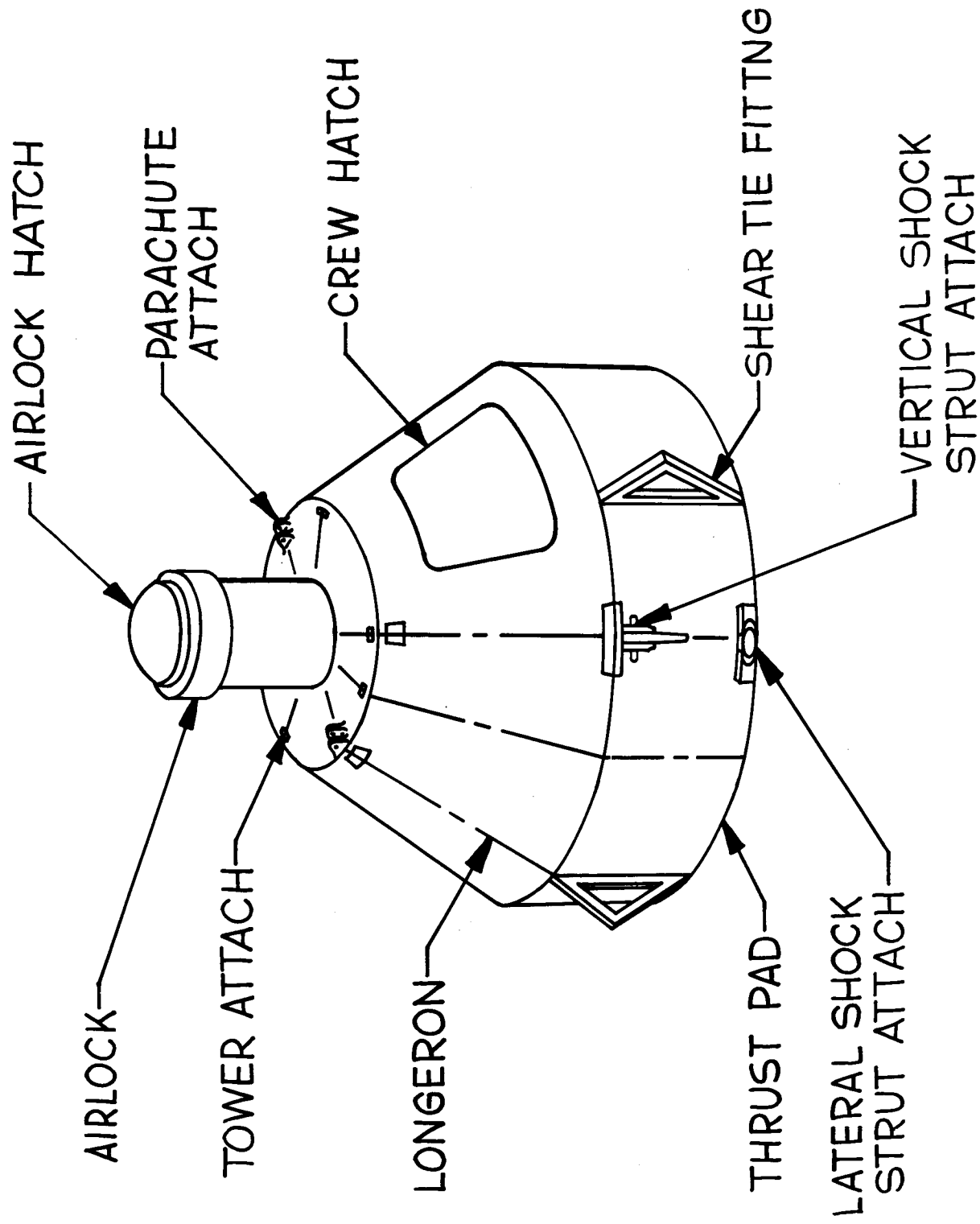
5-62 AP 13285

COMMAND MODULE

COMMAND MODULE STRUCTURAL SYSTEM (INCLUDING THERMAL PROTECTION)



COMMAND MODULE INNER STRUCTURE

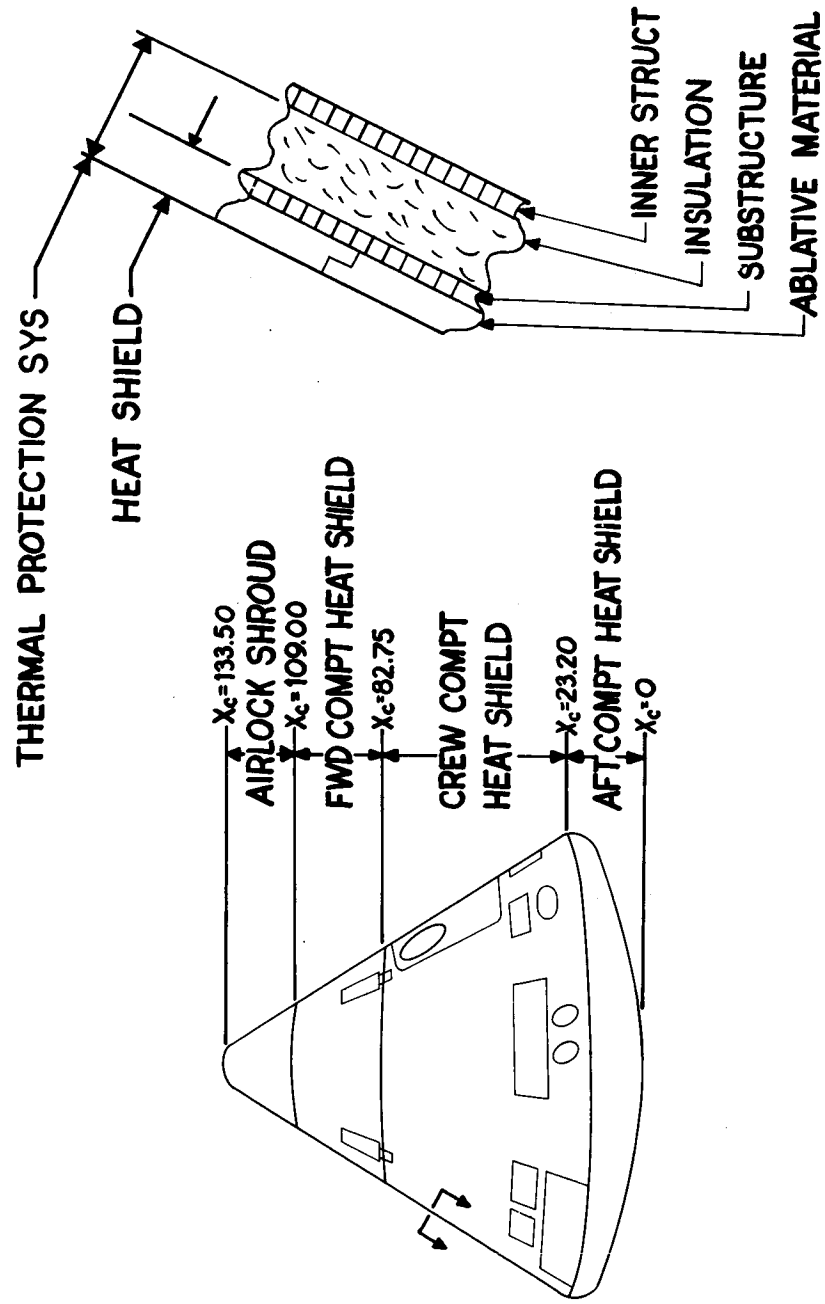


6-62 AP 13730

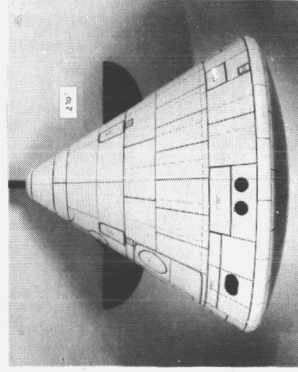
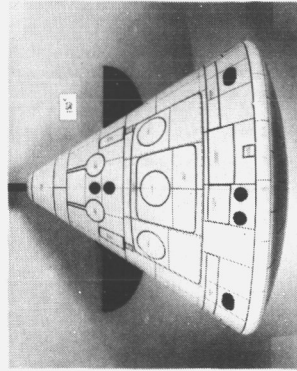
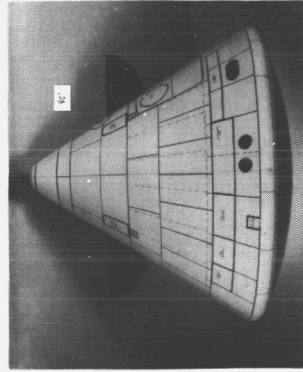
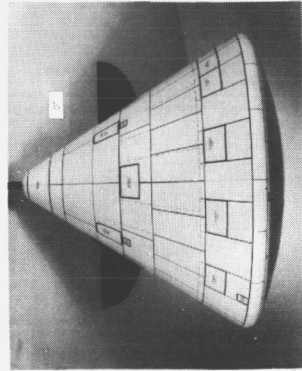
THERMAL PROTECTION SYSTEM

6-62 AP 13731

COMMAND MODULE HEAT SHIELD CONFIGURATION

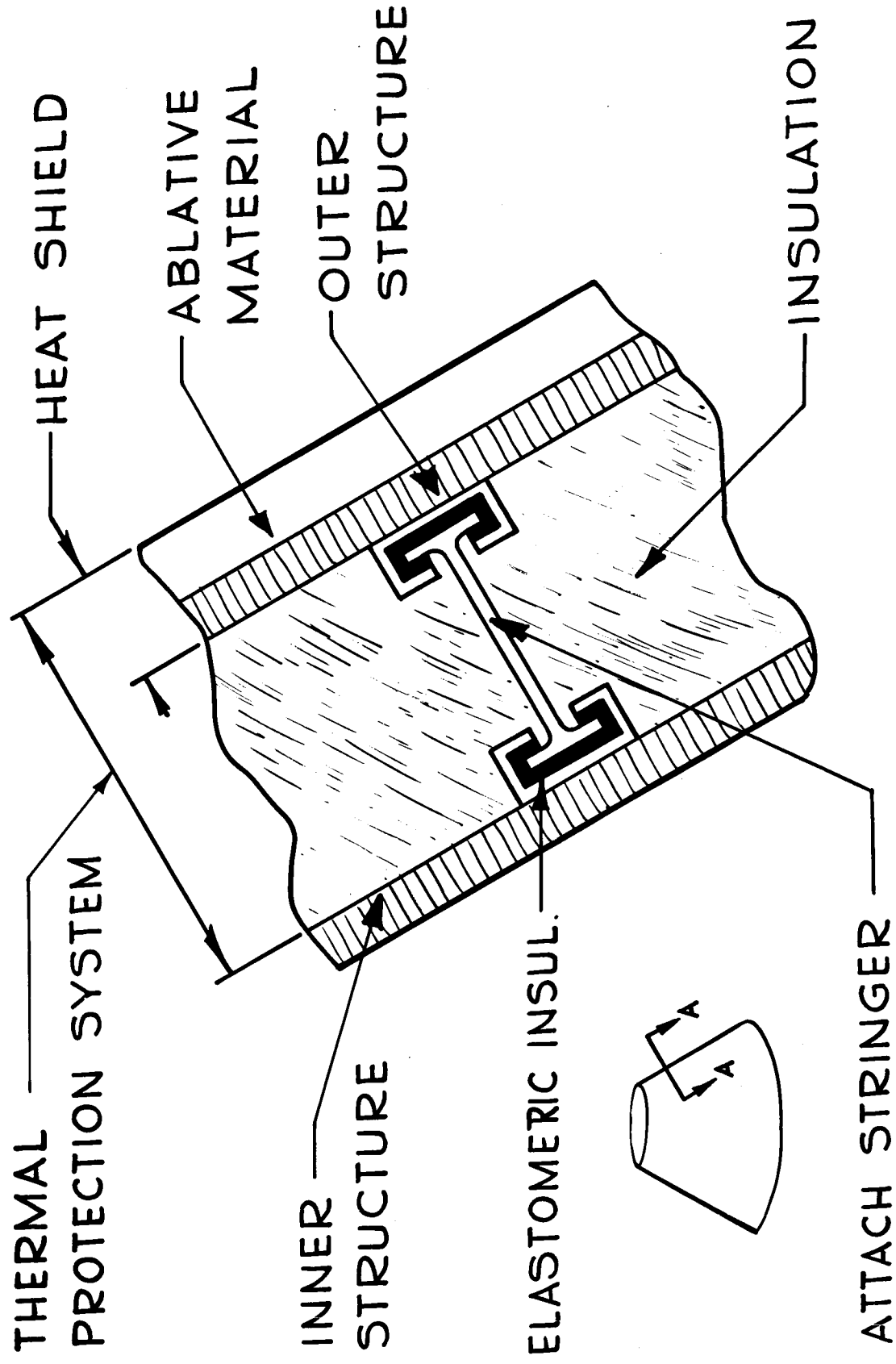


PRELIMINARY TILE LAYOUTS



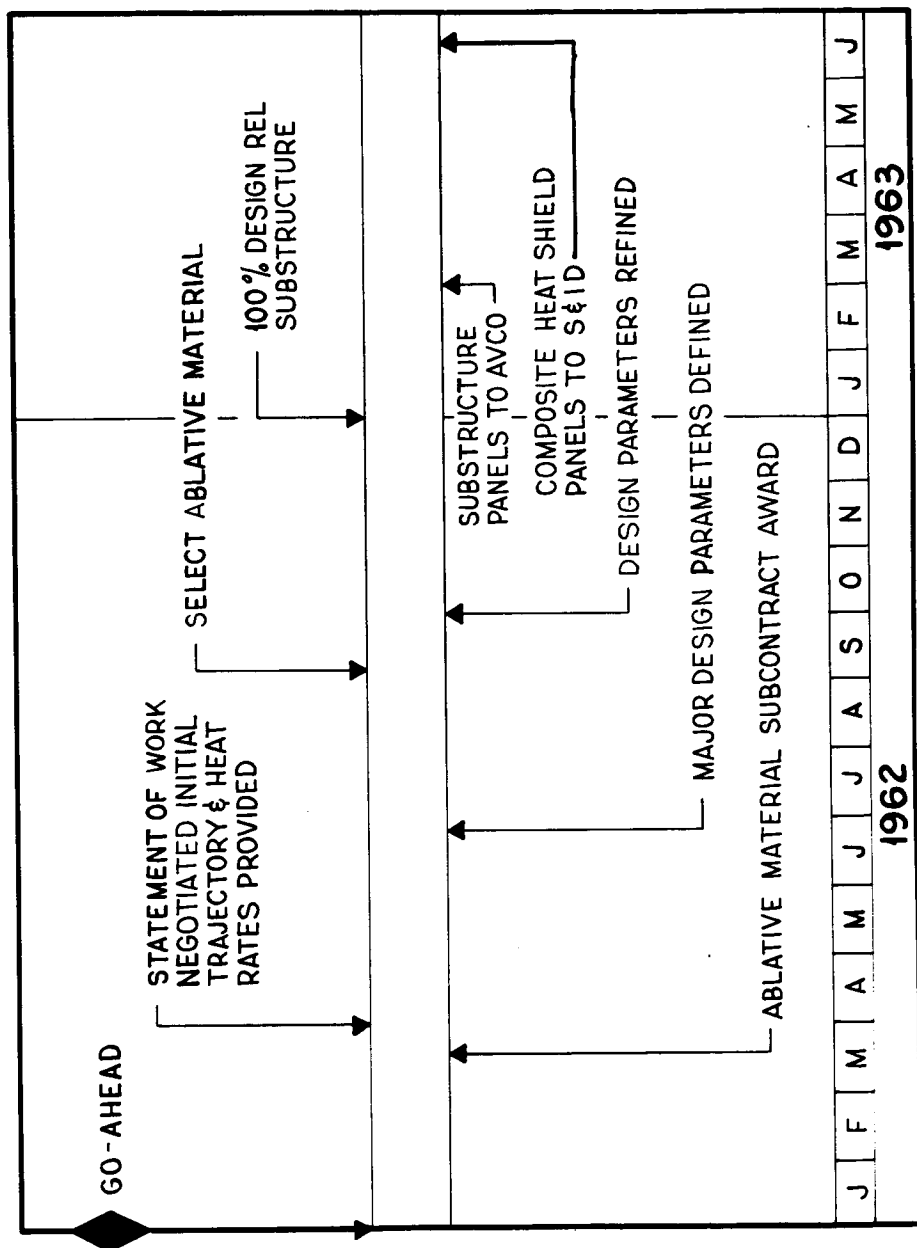
6-62 AP 13573

HEAT SHIELD INSTALLATION



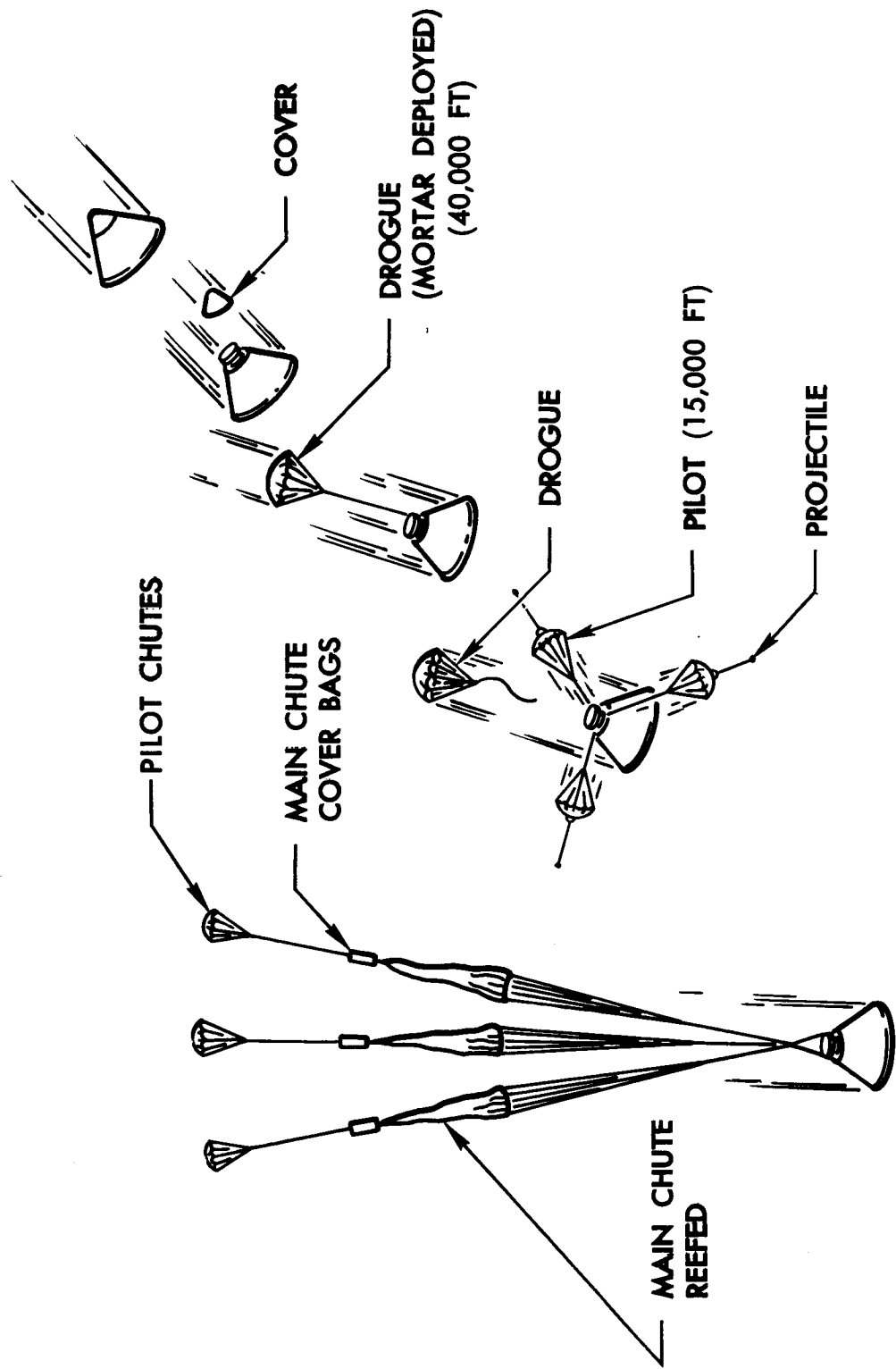
VIEW A-A

PROGRAM SCHEDULE



EARTH LANDING SYSTEM

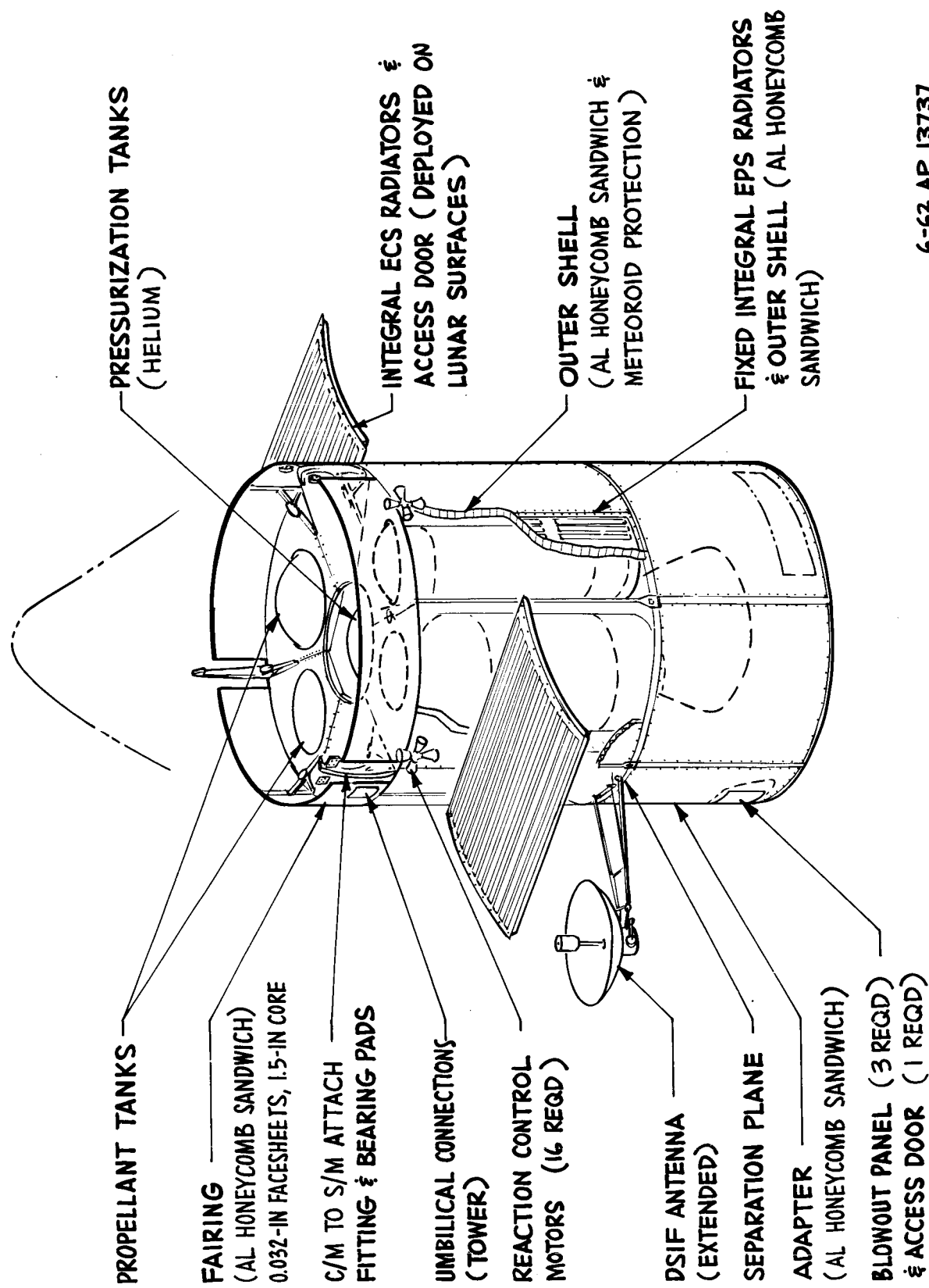
EARTH LANDING SYSTEM



SERVICE MODULE

C-62 AP 13736

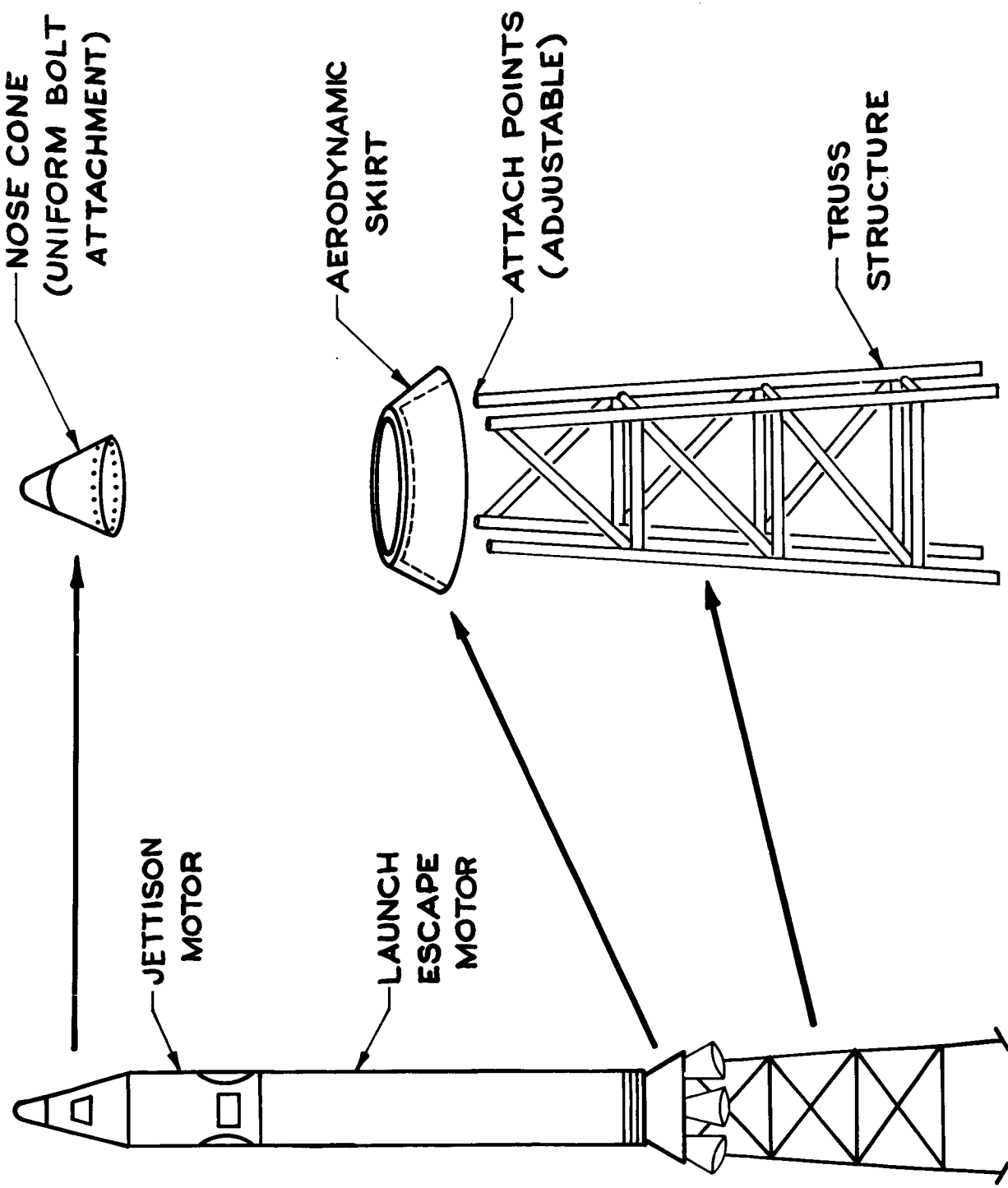
SERVICE MODULE ASSEMBLY COMPLETE



LAUNCH ESCAPE TOWER

6-62 AP 13738

LAUNCH ESCAPE SYSTEM STRUCTURE



● APOLLO WEIGHT STATUS*

COMMAND MODULE

SERVICE MODULE

LAUNCH ESCAPE SYSTEM

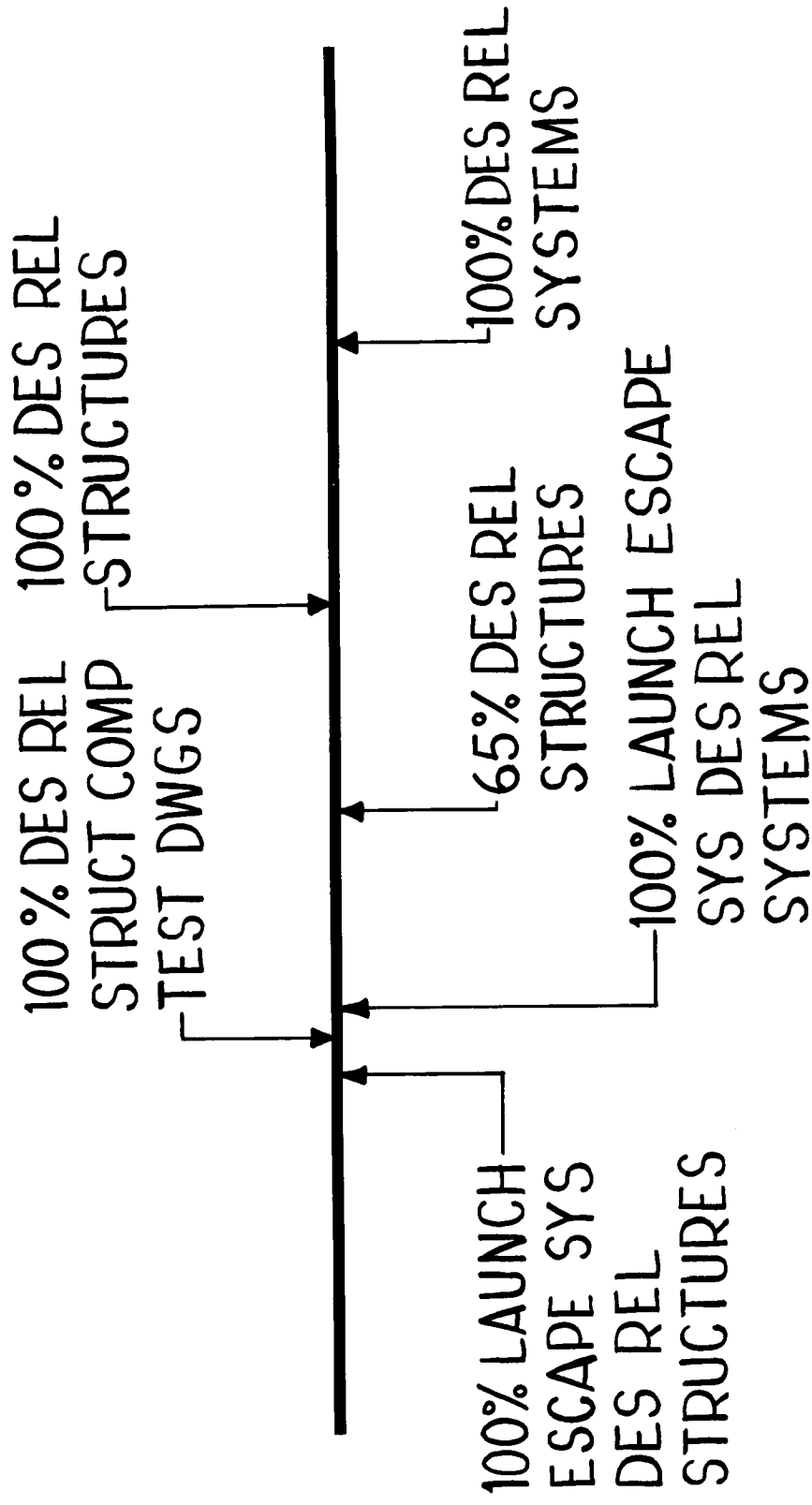
ADAPTOR

●

CURRENT WEIGHT	
GROSS	LESS CONSUMED
8,340	8,130
39,095	31,030
5,900	2,441
700	

*BASED ON DIRECT LUNAR LANDING MISSION

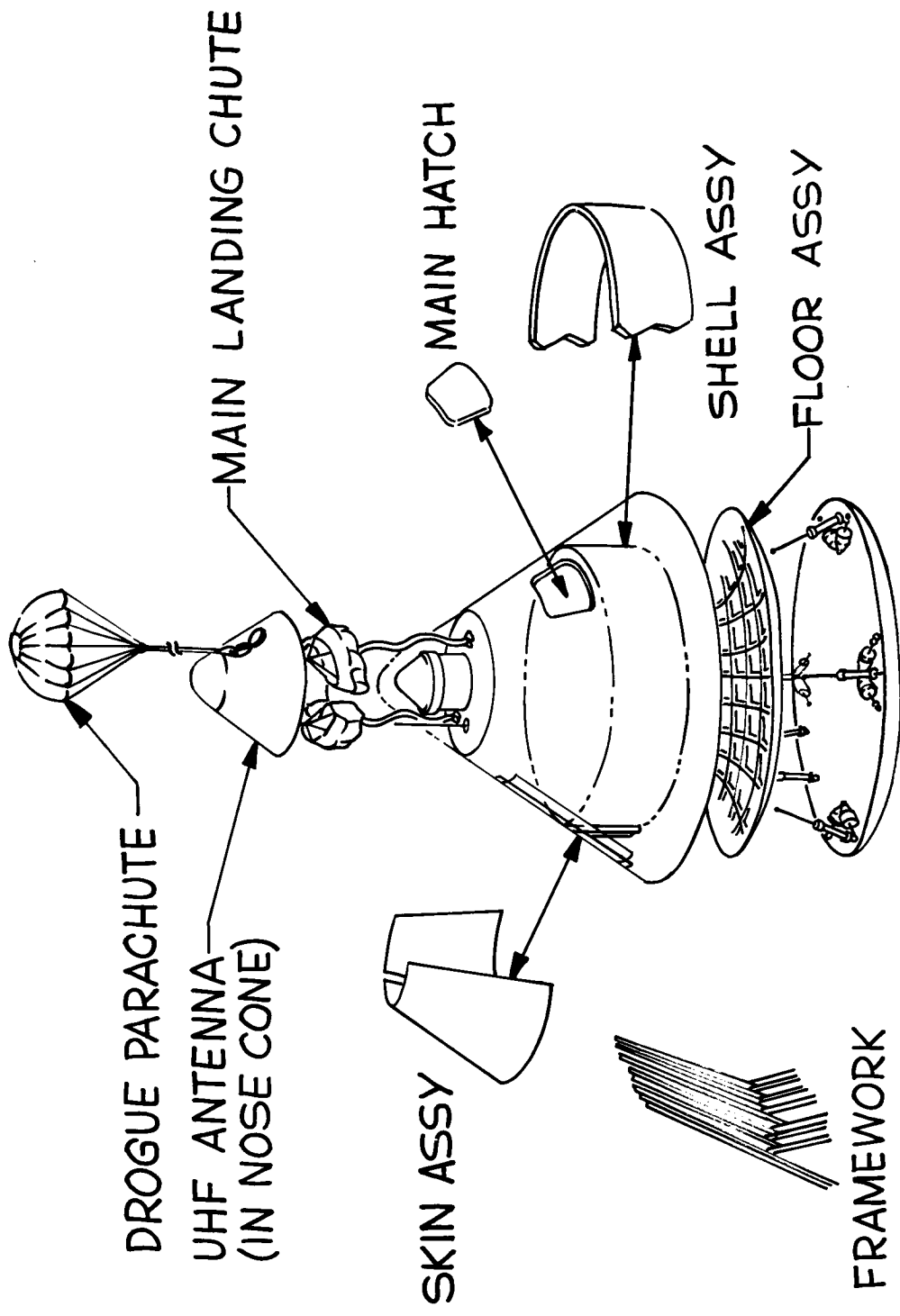
SPACECRAFT DESIGN SCHEDULE



J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
1962												1963							

"BOILERPLATE" TEST PROGRAM

BOILERPLATE DESIGN



IMPACT ATTENUATION SYSTEM

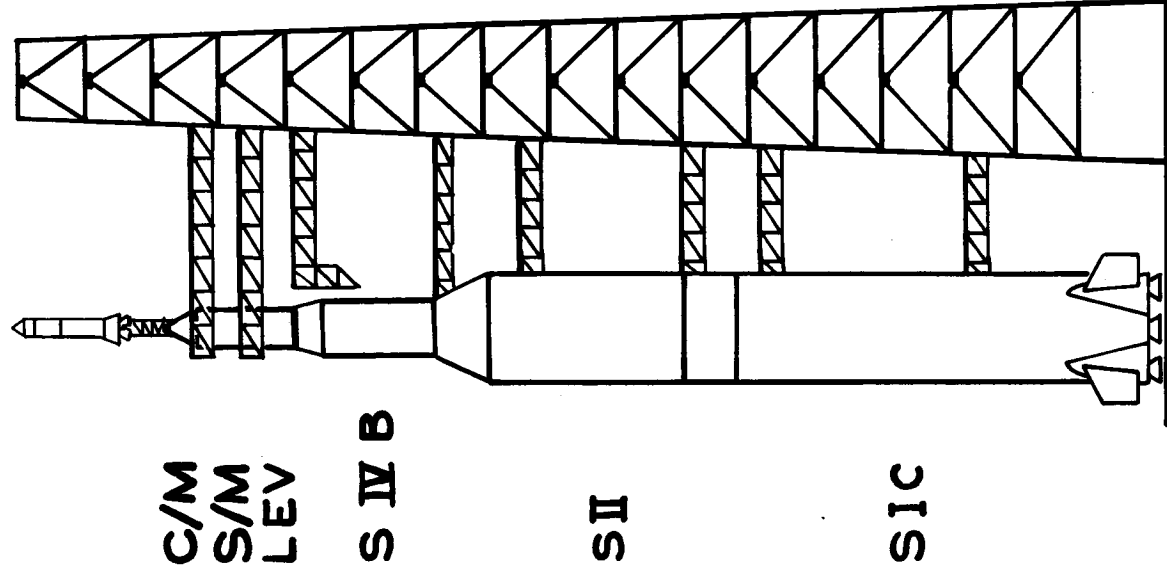
BOILERPLATE TEST SUMMARY

	IMPACT	RECOVERY SYSTEMS		LAUNCH ESCAPE	RECOVERY & HANDLING & TRANSPORT	STRUCTURAL INTEGRITY	S/C BOOSTER COMPATIBILITY	COMMUNICATIONS	GUID & NAV	STAB & CONT	ENVIRON CONT	ELECTRICAL
IMPACT TEST (2)	X											
PARACHUTE TEST (3)	X		X									
DYNAMIC TEST						X	X					
WATER EGRESS FLOTATION R/C AIDS			X		X	X						
PAD ABORT (2)			X	X	X	X						
MAX Q ABORT (3)	X		X	X	X	X						
C-1 BOOSTER DEMONS (2)						X	X					
HIGH ALT ABORT	X		X	X	X	X						
SYSTEMS EVAL TESTS (2)				EMER X ONLY		X	X	X		PARTIAL		X
HOUSE S/C								X	X	X	X	X

SPACE VEHICLE INTEGRATION

C-62 AP 13745

APOLLO SPACECRAFT DESIGN ACCESS REQUIREMENTS



ACCESSIBILITY REQUIREMENTS

- 360-DEG ACCESS
- TOTAL SPACECRAFT HEIGHT

LAUNCH PAD NO. 34 & NO. 37

- ACCESS SUPPLIED BY MOVEABLE GANTRY

LAUNCH PAD NO. 39

- ACCESS SUPPLIED BY TOWER ARMS

SERVICE REQUIREMENTS

UMBILICAL ARMS

- ELECTRICAL REMOTE DISCONNECTS
- FREON REMOTE DISCONNECTS

GANTRY/TOWER ARMS

- ELECTRICAL
- PROPELLANT
- PRESSURIZATION
- ENVIRONMENTAL CONTROL

RELIABILITY DEMONSTRATION

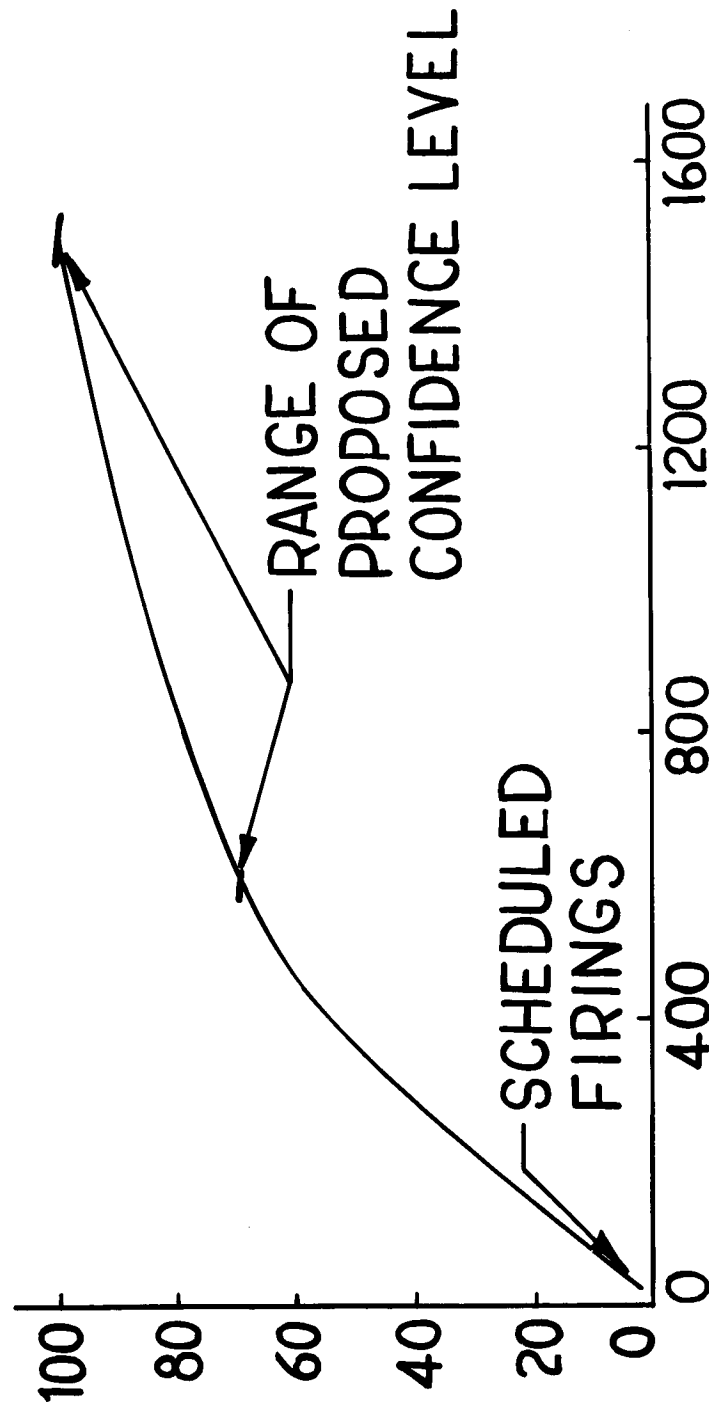
6-62 AP 13747

CONVENTIONAL RELIABILITY DEMONSTRATION

LAUNCH ESCAPE MOTOR

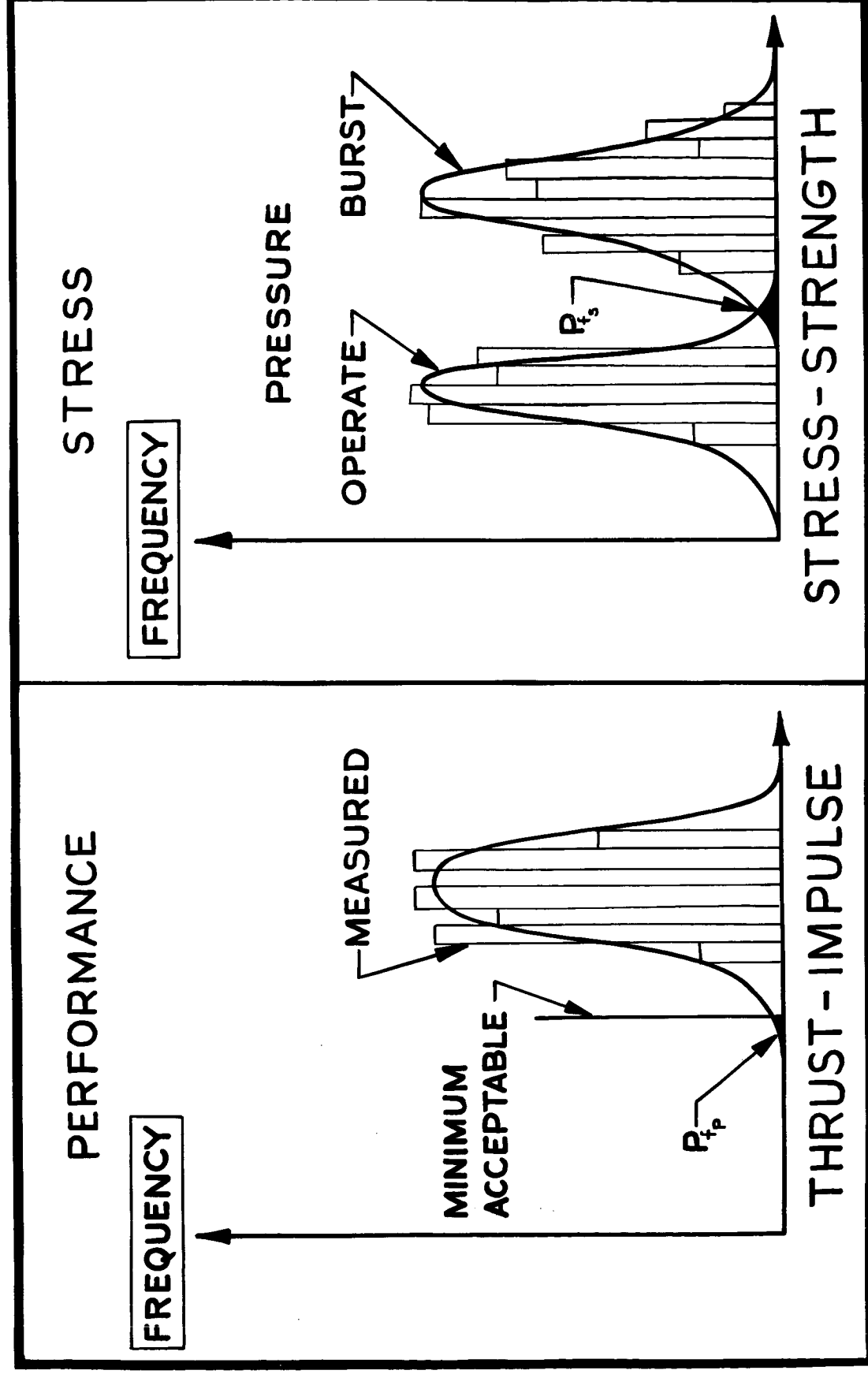
REQD RELIABILITY=0.998

CONFIDENCE
LEVEL (%)



FIRINGS WITH NO FAILURES

STATISTICAL ANALYSIS



CRITERION : $P_{fp} + P_{fs} \approx 0.002$ AT 90% CONFIDENCE LEVEL

SYSTEM RELIABILITY STUDIES

6-62 AP 13750

SUMMARY OF RESULTS

	MISSION SUCCESS		CREW SAFETY	
	REQD	EST	REQD	EST
UNIMPROVED PARTS				
• GUID & NAV	994	930	-	-
• STAB & CONT	995	810	-	-
• TELECOM	998	975	-	-
MINUTEMAN PARTS & METHODS				
• GUID & NAV	994	994	-	-
• STAB & CONT	995	986	-	-
• TELECOM	998	998	-	-
• ELECT SYSTEMS (UNIMPROVED)		.877		9987
• ELECT SYSTEMS (GUID & NAV UNIMPROVED, STAB & CONT, TELECOM MINUTEMAN)	989	.953	9998	9998
• ELECT SYSTEMS (ALL MINUTEMAN)		991		99998

RELIABILITY TASKS UNDERWAY

- - REFINE SUBCONTRACTOR PROGRAM REQUIREMENTS
 - ANALYSIS & DESIGN
 - PARTS USAGE
 - QUALIFICATION-RELIABILITY TEST
- - REFINE RELIABILITY MODELS
 - TIME-LINE ANALYSIS
 - REDUNDANCY, ON-BOARD MAINTENANCE, ALTERNATE MODES
- - DETAILED GSE CRITERIA
 - USE OF HIGH-RELIABILITY PARTS
 - 2ND QUARTERLY PROGRESS REPORT

STRUCTURES TASKS UNDERWAY

- COMPLETE DETAIL DESIGN
- START RELEASE OF SPACECRAFT DRAWINGS
- CONDUCT INITIAL ENGINEERING EVALUATION TESTS
- REVIEW MOCKUP
- INITIATE FABRICATION OF STRUCTURAL COMPONENT TEST ARTICLES

PROJECT INTEGRATION TASKS UNDERWAY

- **REVISD PROGRAM PLAN**
- **INTEGRATED CHECKOUT PLAN**
- **INTERFACE CONTROL DRAWINGS
IMPLEMENTED**
- **TOP SPECS REVISED PER NEW
DOCUMENTATION PROPOSAL**
- **PRELIMINARY MOCKUP INSPECTED**
- **PRELIMINARY CONTINGENCY OPERATION
STUDY (INCLUDING ABORT SENSING)**

POWER SYSTEMS & GSE

ACCOMPLISHMENTS

ACCOMPLISHMENTS

THERMODYNAMICS

- ECS HEAT REJECTION SYSTEM CONCEPT ESTABLISHED
- HEAT TRANSFER WIND TUNNEL TEST
- HEAT SHIELD AERO-HEATING RATES
- SPACE RADIATOR SIZING
- C/M RCS ENTRY TEMPS

PROPULSION

- SUBCONTRACTOR SELECTIONS
 - LES TOWER JETTISON MOTOR THIOKOL
 - SERVICE PROPULSION ENGINE AEROJET
 - REACTION CONTROL ENGINE MARQUARDT
- SERVICE MODULE PROPULSION CONFIGURATION ESTABLISHED

ACCOMPLISHMENTS (CONT)

PROPULSION

- LAUNCH ESCAPE SYSTEM MOTOR CONFIGURATION ESTAB
- SUB-SYSTEM PERF REPORTS SUBMITTED

ELECTRICAL SYSTEM

- FUEL CELL SUBCONTRACTOR SELECTED - P & W
- ELECT POWER DISTRIBUTION CONFIG ESTABLISHED
- EBW VS HOT WIRE PYROTECHNIC INITIATION STUDY
- SEQUENCING SYSTEM CONCEPT ESTABLISHED
- SUB-SYSTEM PERFORMANCE REPORT SUBMITTED

ENVIRONMENTAL SYSTEM

- ESTABLISHED CONFIGURATION
- LUNAR REFRIGERATION DELETED

ACCOMPLISHMENTS (CONT)

ENVIRONMENTAL SYSTEM

- RELEASED PRELIM TEST PLAN FOR ENVIR PROOF S/C
- PRELIMINARY ECS PACKAGE DESIGN LAYOUT COMPLETE
- SUB-SYSTEM PERFORMANCE REPORT SUBMITTED

GSE & TRAINERS

- EARLY B/P HANDLING GSE DESIGN RELEASED
- TELEMETRY, LAUNCH CONTROL, & MAINTENANCE TRAILERS
PRELIMINARY DESIGN
- DOCUMENTS SUBMITTED
 - S/C MODIFICATION & CHECKOUT CENTER REQUIREMENTS
 - PROPULSION TEST FACILITY REQUIREMENTS
 - TRAINING EQUIPMENT REQUIREMENTS & PERFORMANCE SPECS
 - GSE CHECKOUT CONCEPT

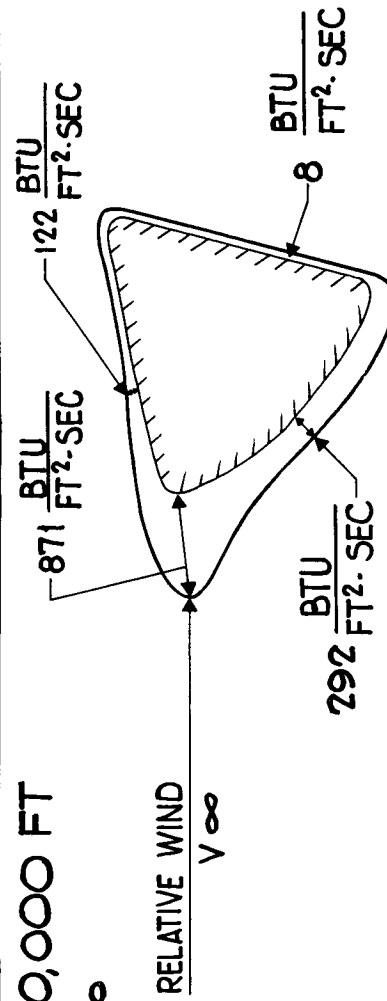
THERMODYNAMICS

HEAT LOAD SUMMARY

TRAJECTORY	ENTRY VELOCITY	ENTRY ANGLE	RANGE NM	MAX "G"	STAG PT HT (MAX)	STAG PT HT LOAD (MAX)
OVERSHOOT	36,080	-5.3	5440	2	468 $\frac{B}{FT^2 SEC}$	141,000 $\frac{B}{FT^2}$
MAX R UNDERSHT	36,080	-7.4	3510	10	871	96,000
MIN R UNDERSHT	36,080	-7.4	1157	10	871	64,000
20 "G" EARTH ORBIT	26,000	-6.75	400	20	420	17,000
1.8 "G" EARTH ORBIT	26,000	-1.0	7170	1.8	95	84,000

ENTRY ALT = 400,000 FT

ENTRY $\alpha = 33^\circ$

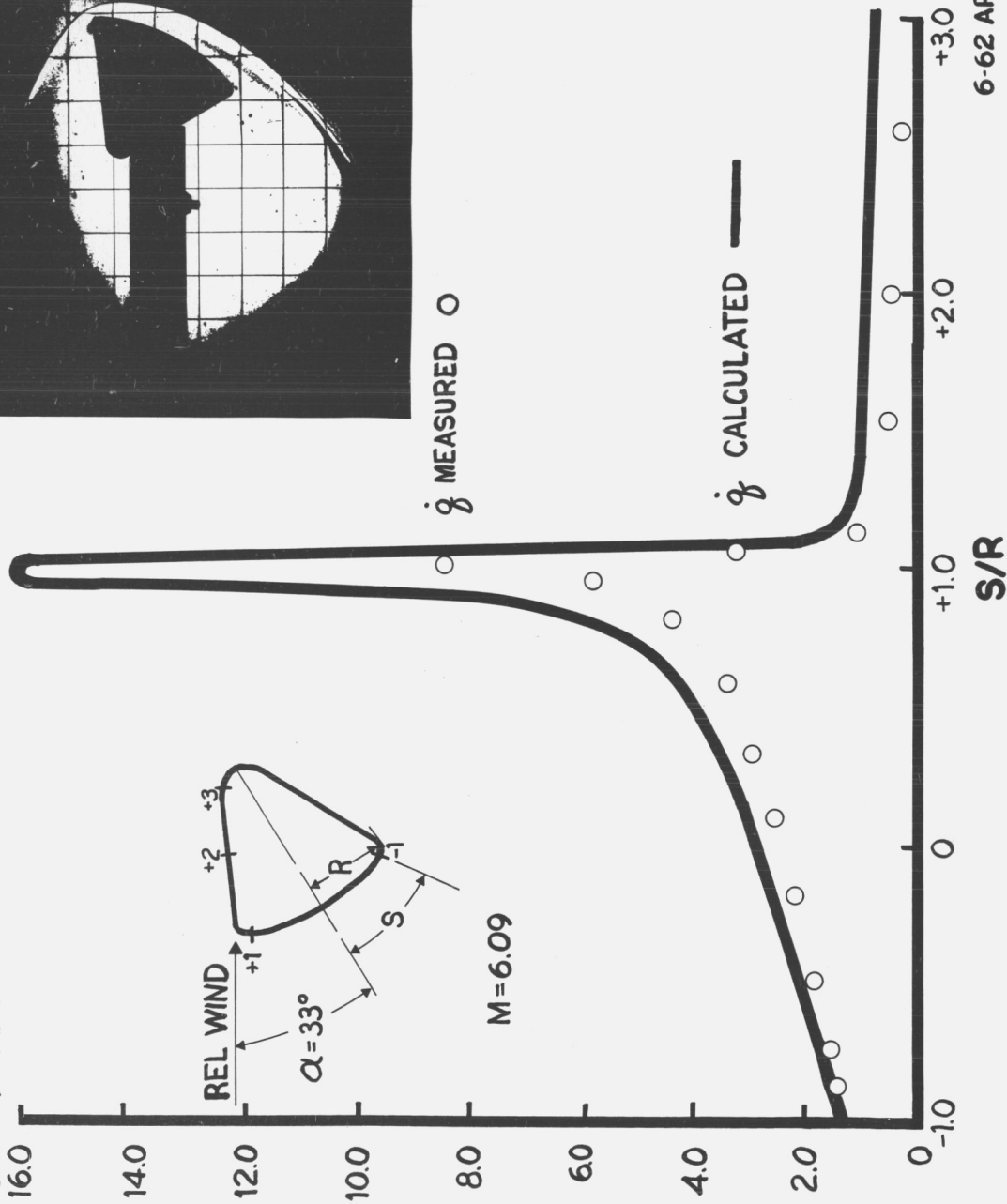


WIND TUNNEL AERO-HEATING

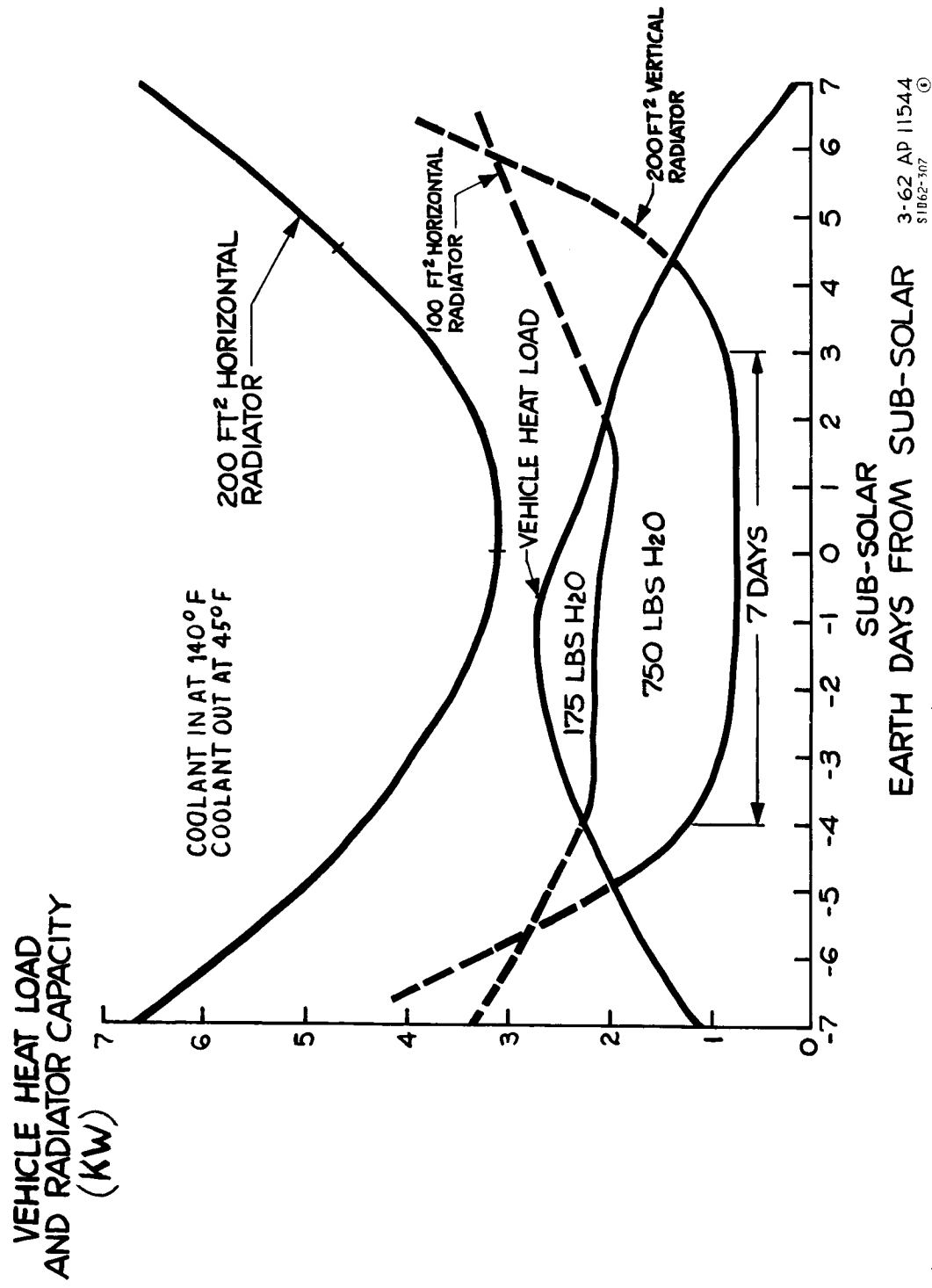
• TEST RESULTS

ENTRY SHOCK CONFIGURATION

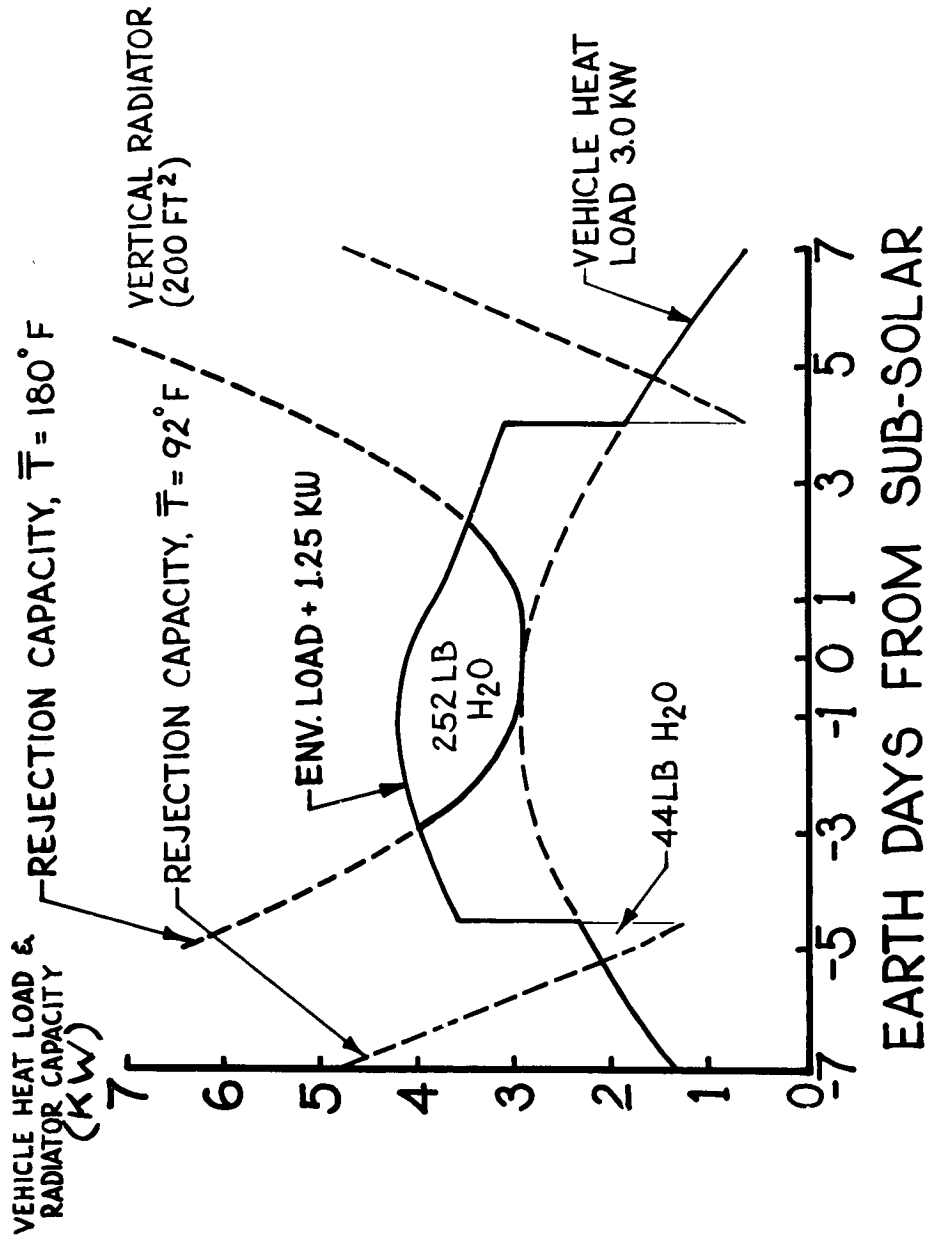
HEAT TRANSFER DISTRIBUTION
BTU/SQ FT-SEC



HEAT REJECTION CAPACITY VS HEAT LOAD

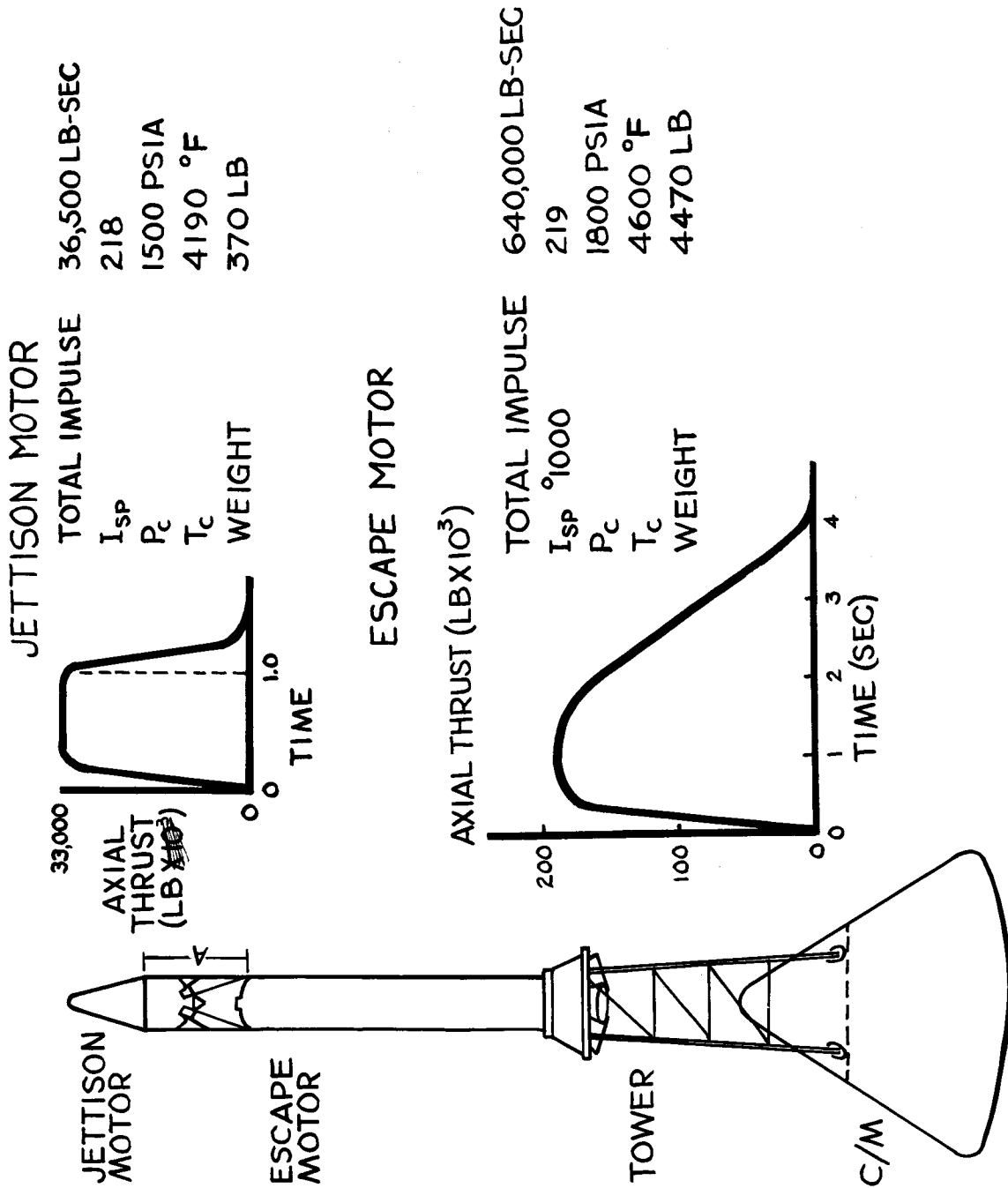


SPACE RADIATOR-REFRIGERATION SYSTEM-WATER EVAPORATION



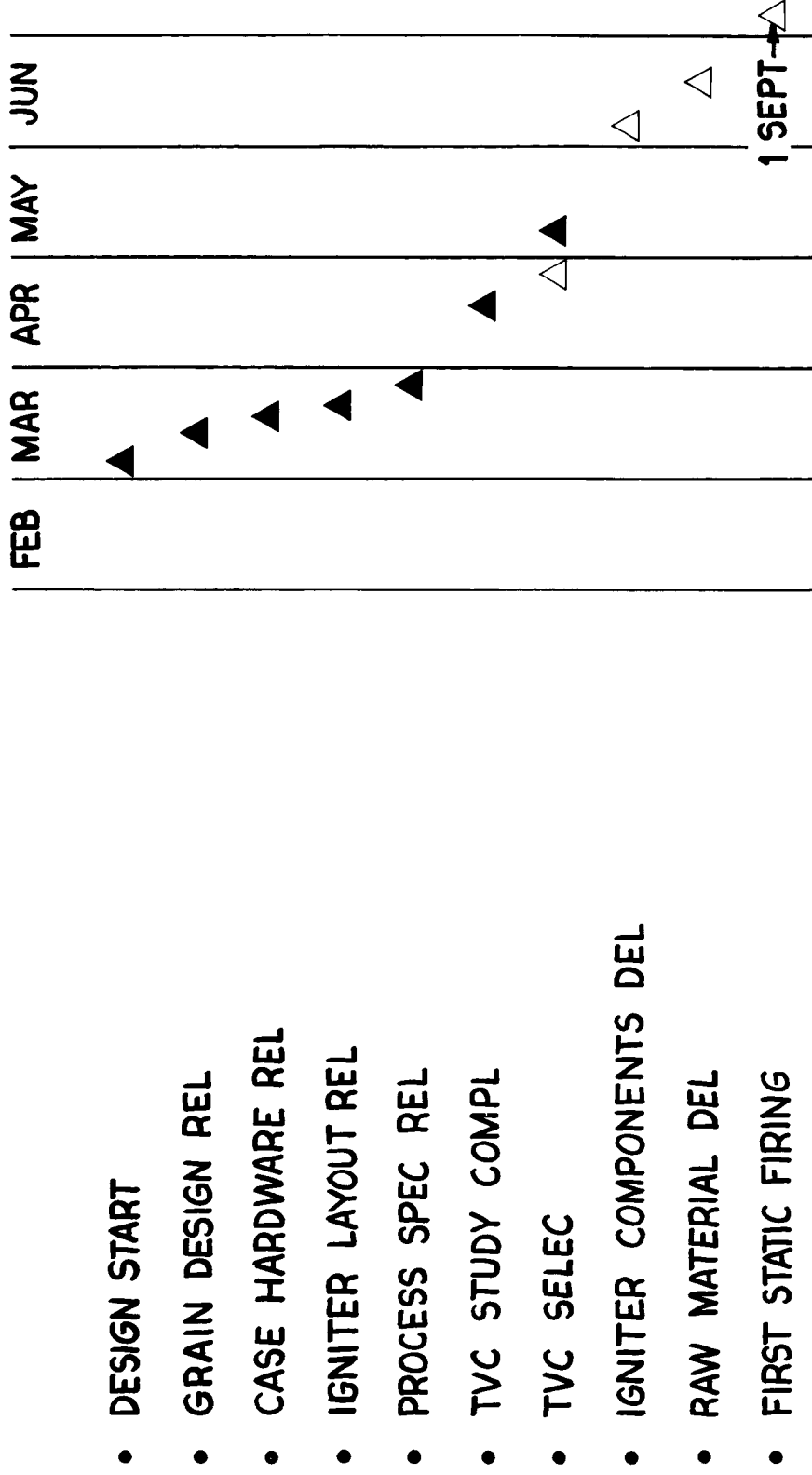
PROPULSION

LAUNCH ESCAPE SYSTEM CONFIGURATION



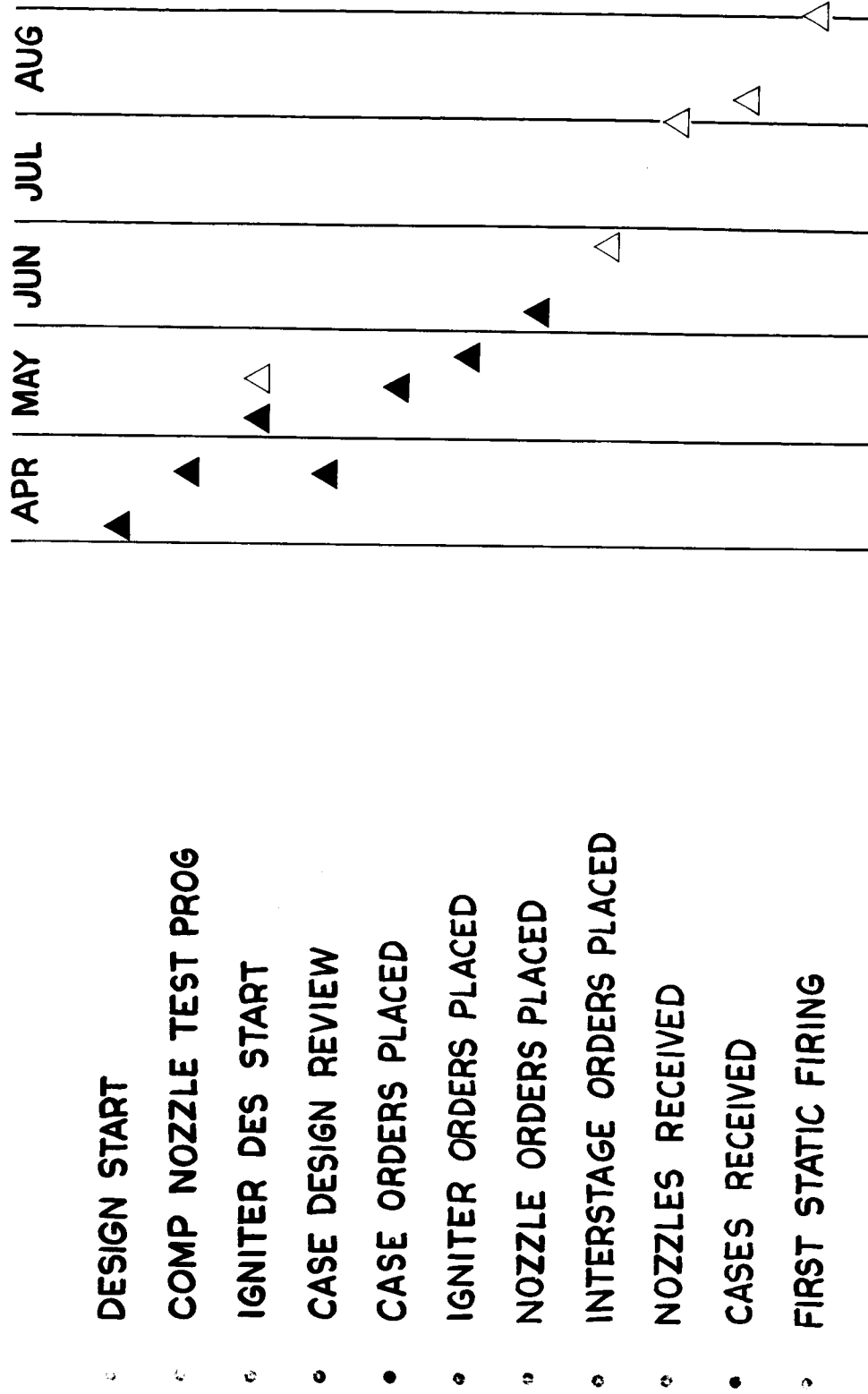
LAUNCH ESCAPE MOTOR-LOCKHEED

MILESTONE SCHEDULE

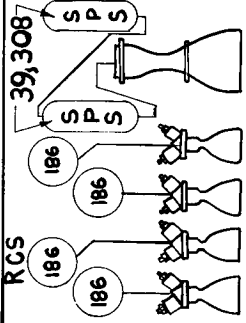
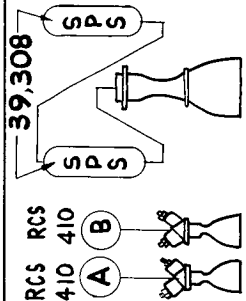
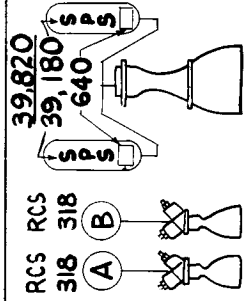
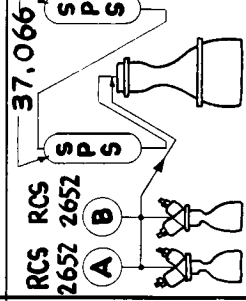


TOWER JETTISON MOTOR - THIOKOL

MILESTONE SCHEDULE



SERVICE MODULE PROPELLANT SYSTEM COMPARISON STUDY

	RCS FOR SETTLING SPS		RCS FOR SETTLING SPS		POS EXPULSION IN SPS		POS EXPULSION IN RCS	
	NO SPS POS EXPULSION NO INTERCONNECT QUAD RCS	NO SPS POS EXPULSION NO INTERCONNECT DUAL RCS	NO SPS POS EXPULSION NO INTERCONNECT DUAL RCS	NO SPS POS EXPULSION NO INTERCONNECT DUAL RCS	NO INTERCONNECT DUAL RCS	FOR SPS STARTS DUAL RCS		
CONSIDERATIONS								
REDUNDANT PROPELLANT	150 -0-	410 -0-	310 320	2460 -0-				
PROP REQD FOR FILL EFF %/F RATIO EXPULSION EFF	74 790	82 790	82 807	246 749				
TRAPPED PROPELLANT	3.2	39.2	39.2	60				
PROPELLANT ON BOARD	40,919	41,039	41,384	43,425				
COMPONENT WT (INCL He)	2011	1998	2098	2126				
MISC & SUPPORT	272	270	346	302				
S/M STRUCTURAL CHANGE	104	—	—	—				
SYSTEM TOTAL	43,306	43,307	43,828	45,853				

C/M REACTION CONTROL ENGINE

THRUST - 100 LB

O/F RATIO - 2:1

SPECIFIC IMPULSE

STEADY STATE - 300 SEC MIN

PULSE MODE - 250 SEC AT 10 MS PULSE

MIN IMPULSE - 1 LB - SEC

THRUST START TRANSIENT - 12.5 MS TO 90%

RELIABLE LIFE - 200 SEC

WEIGHT - 5.5 LB

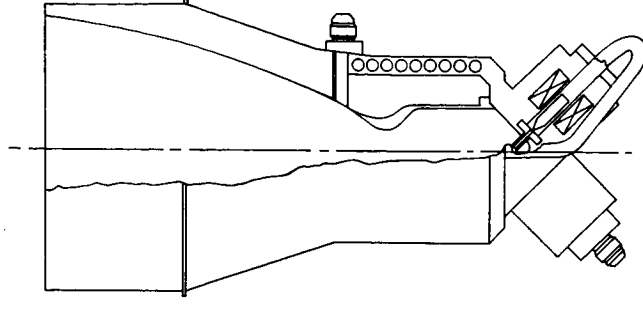
COLD WALL COOLING SYSTEM

PROPELLANT INLET

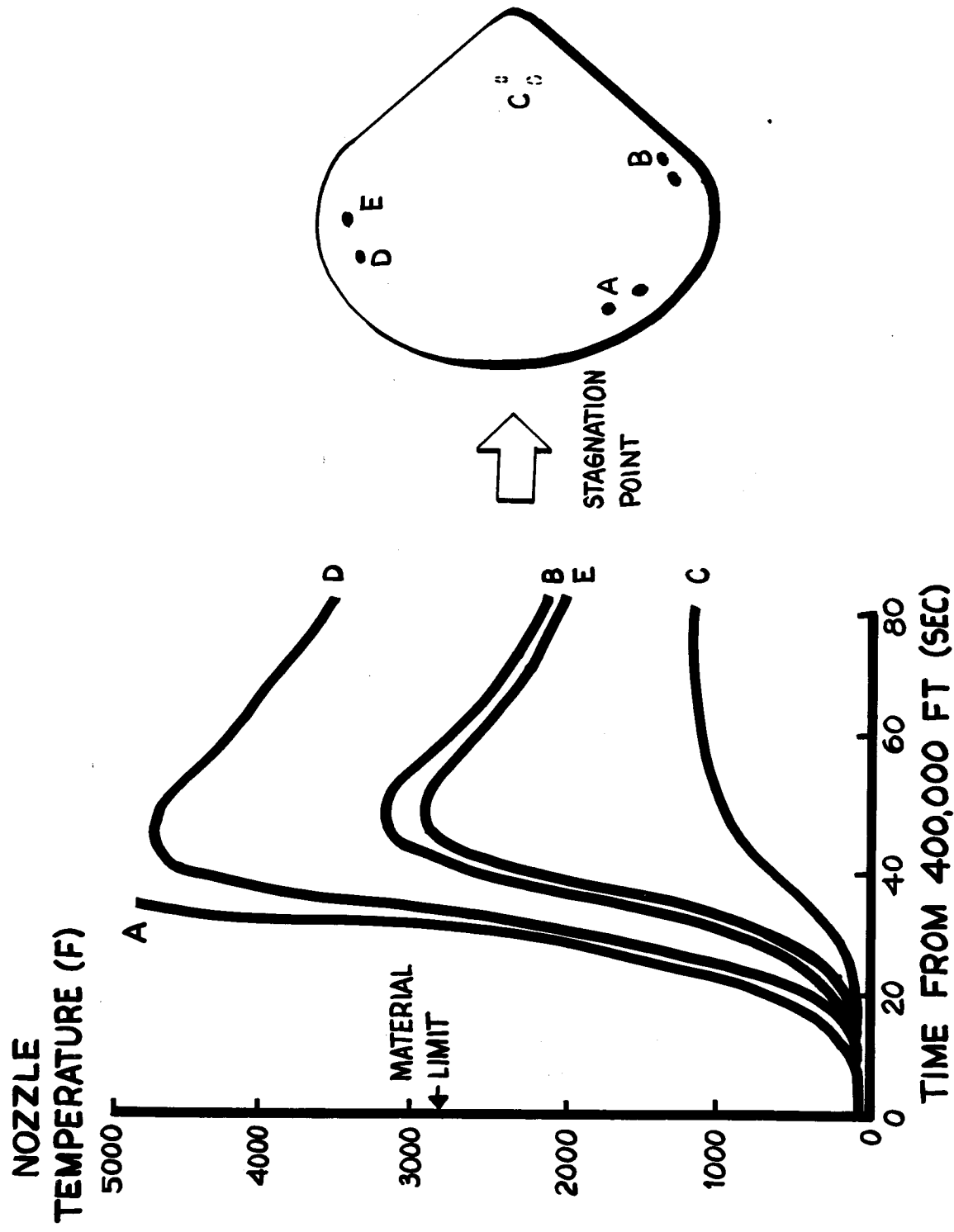
PRESSURE - 170 PSIA

TEMP 40F TO 100F

$\frac{40}{1}$ EXPANSION RATIO

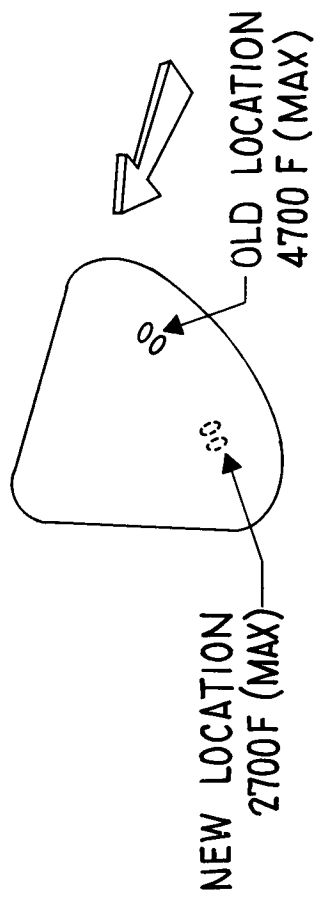


COMMAND MODULE RCS ENTRY HEATING

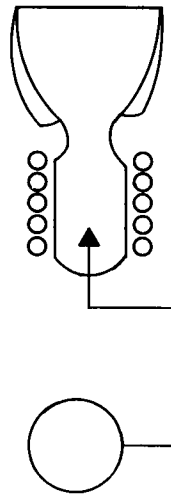


RCS ENTRY ALTERNATIVES

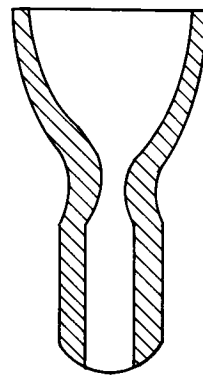
- RELOCATION



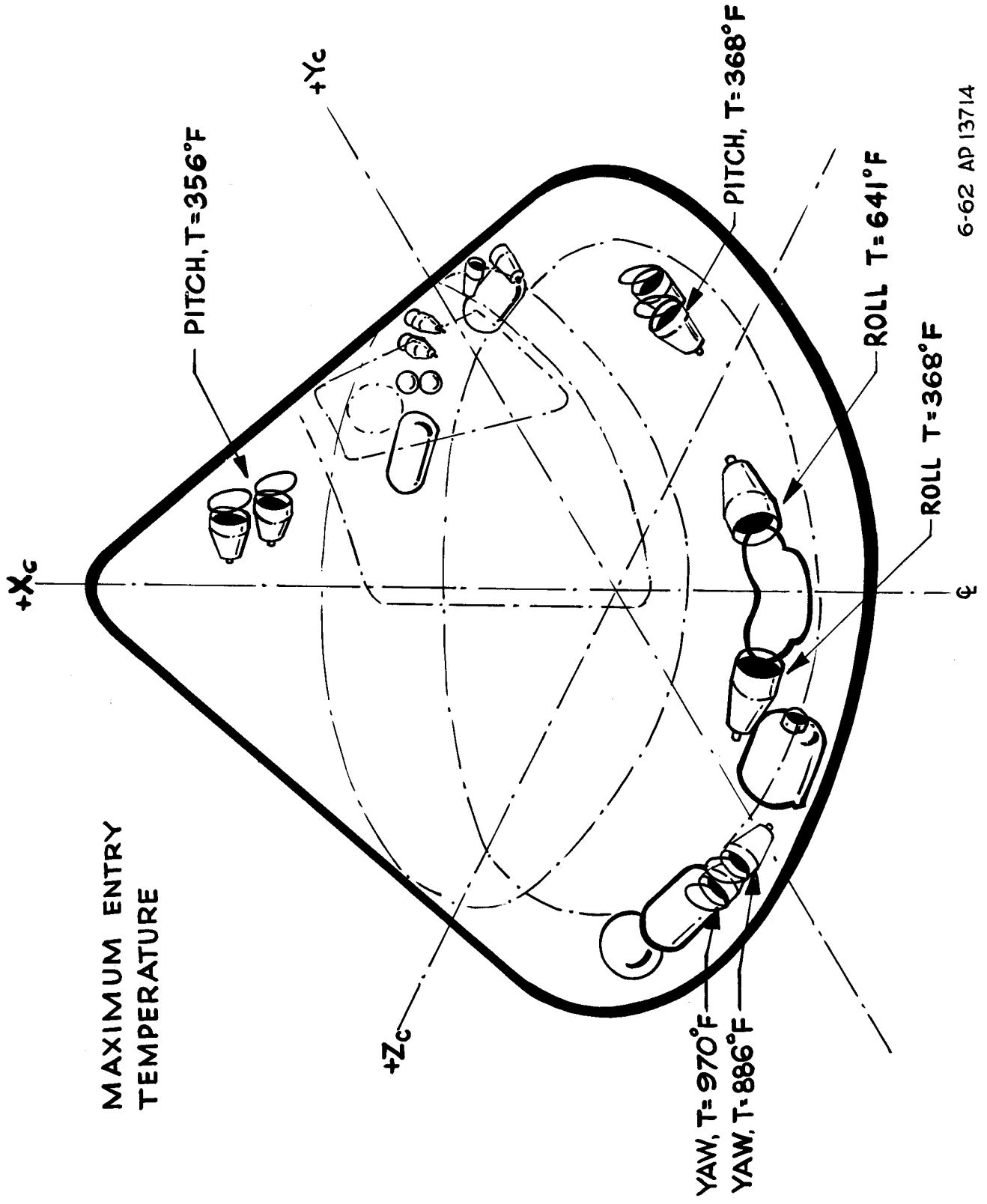
- COOLANT BLEED



- ABLATIVE WALL



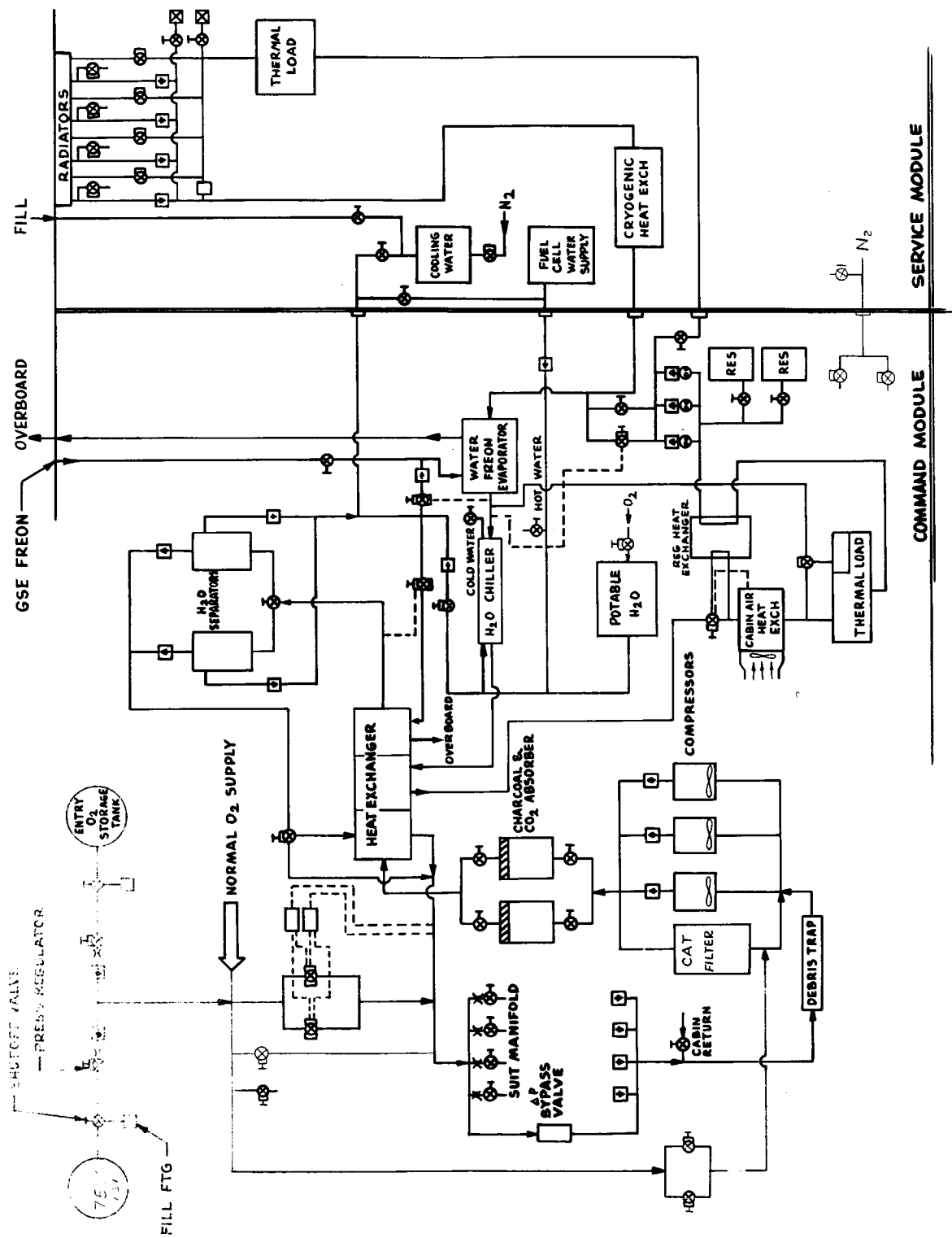
RCS ENGINES RELOCATION



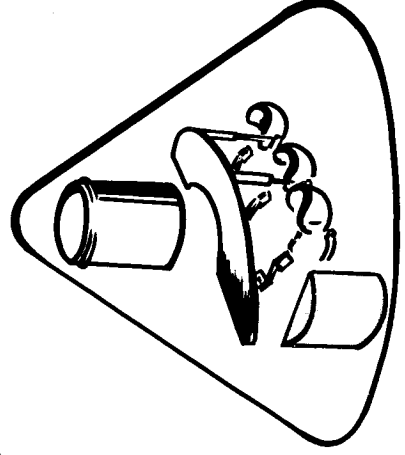
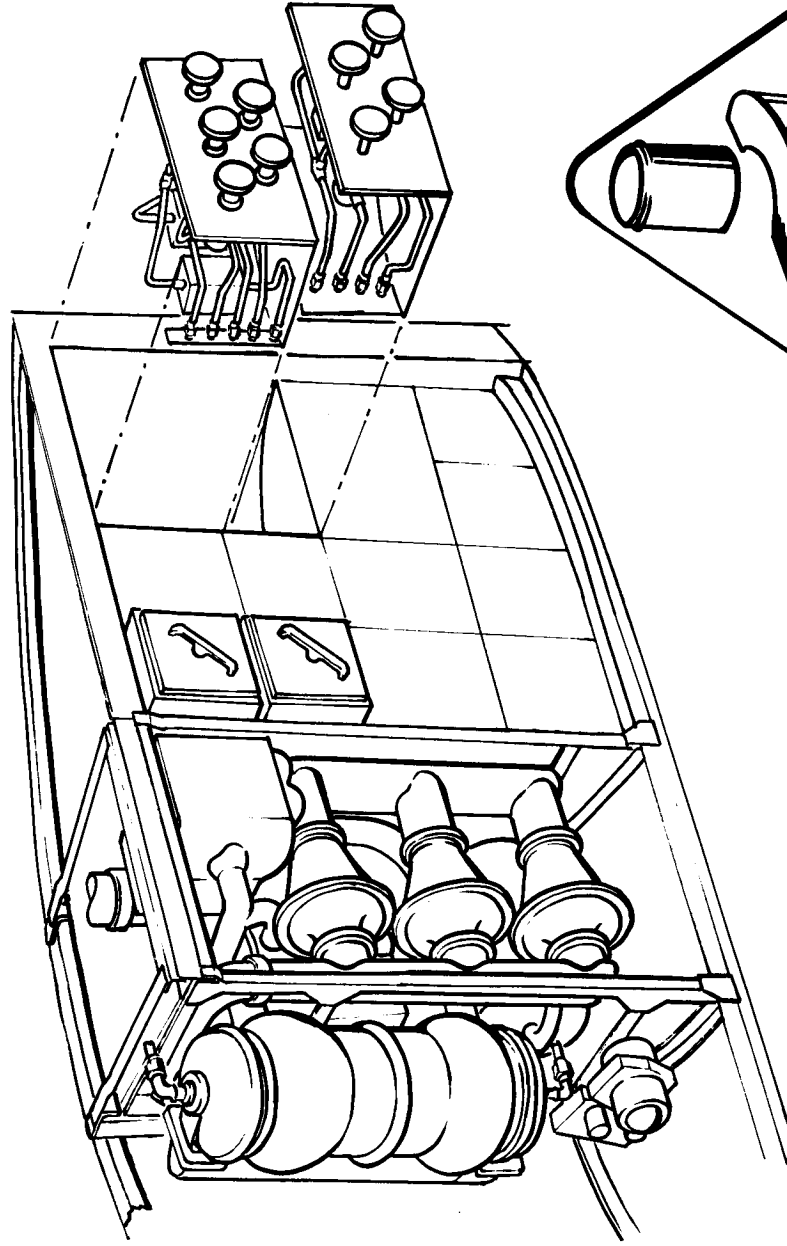
ENVIRONMENTAL CONTROL SYSTEM

6-62 AP 13715

ECS SCHEMATIC (CURRENT)



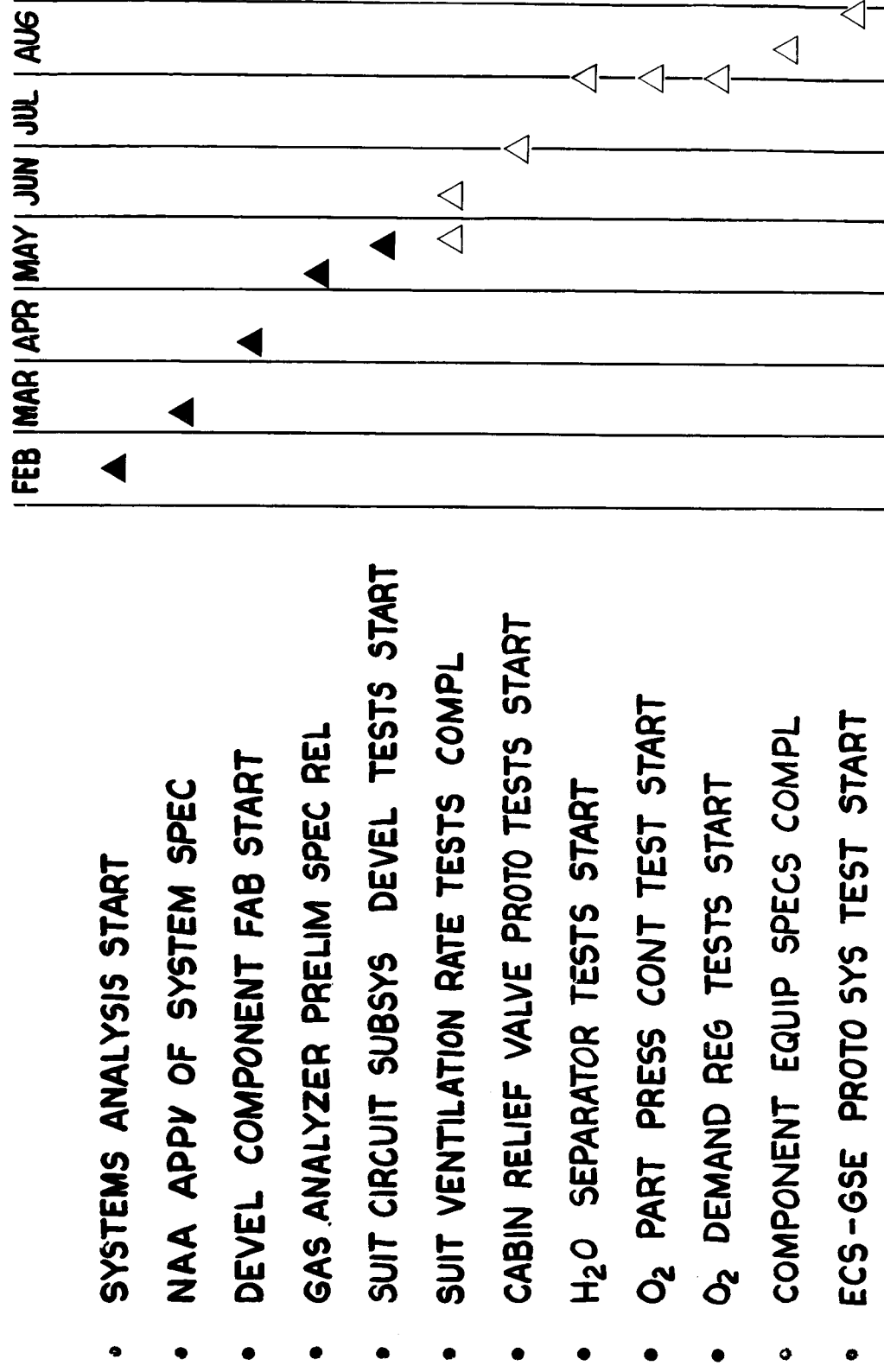
ENVIRONMENTAL CONTROL SYSTEM



6-62 AP 13716

ENVIRONMENTAL CONTROL SYSTEM

AIRESEARCH MILESTONES



TASKS UNDER WAY

TASKS UNDER WAY

THERMODYNAMICS

- WIND TUNNEL TESTS & AERO-HEATING ESTIMATES
- C/M RCS HEATING TEST
- C/M & S/M TEMP PREDICTIONS
- SURFACE COATING THERMAL RADIATION TESTS
- ROCKET ENGINE PLUME EFFECTS

TASKS UNDER WAY (CONT)

PROPULSION

- DESIGN LAYOUTS ~ PROPELLANT SYSTEMS
- EQUIP PROCUREMENT SPECS ~ PROPELLANT SYSTEMS
- ENGINE TEST STAND - SPS
- RCS BREADBOARD DESIGN & FABRICATION
- C/M & S/M RCS INSTALLATION DESIGN

ELECTRICAL SYSTEM

- SUPPLIER SELECTION (BATTERIES & STATIC INVERTER)
- EQUIPMENT PROCUREMENT SPECS

TASKS UNDER WAY (CONT)

ELECTRICAL SYSTEM

- SEQUENCER SYSTEM BREADBOARD
- FUEL CELL RADIATOR DESIGN

ENVIRONMENTAL SYSTEM

- ECS PACKAGING & INSTALLATION DESIGN
- SUPPLIER SELECTION-SUPER GAS STORAGE
- HEAT TRANSPORT LIQUID SELECTION
- EC S RADIATOR DESIGN

TASKS UNDER WAY (CONT)

GSE & TRAINERS

- **PROCUREMENT SPEC FOR BOILERPLATE GSE**
- **REV TRAINING EQUIP PERF SPEC**
- **PROCUREMENT SPEC FOR TRAINING
EQUIPMENT COMPUTERS**
- **GSE CHECKOUT COMPUTER COMPLEX
PROCUREMENT SPEC**
- **DEFINITION OF FUNCTIONAL REQMTS &
CHARACTERISTICS FOR DATA TRANSMISSION
SYSTEM**
- **SPECS FOR DATA TRANSMITTING &
RECEIVING STATIONS**

●

LIFE, FLIGHT, ELECTRONICS & SIMULATION 2ND PROGRESS REPORT

●

PROMISED LAST TIME

1	DESIGN CRITERIA	(PUBLISHED)
2	GOSS PRELIM REQMTS	(PUBLISHED)
3	ANTENNAS CONCEPT	(OK)
4	$\Delta V = f(\omega, p, \dots)$	(INCLUDED HEREIN)
5	LITTLE JOE II PROGRAM	(RECOMMENDED)
6	SA-10 PRELIM INSTR	(PARTLY)
7	RENDEZVOUS DATA	(PART SIMULATION)
8	TELESCOPE REQMTS	(PARTLY COMPLETED)
9	RADAR ALT REQMTS	(PARTLY COMPLETED)
10	COUCH & DISPLAY	(1ST TRY COMPLETE)
11	WINDOW REQMTS	(UNDER ANALYSIS)
12	IN-FLIGHT TEST LOGIC	(UNDER ANALYSIS)

PROGRESS

1. FIRST DISPLAY CONFIGURATION
2. WEIGHT, VOLUME, BUDGETS & CONFIGURATION TO ELECTRONICS & LIFE SYSTEMS
3. CHARACTERISTIC VELOCITY REQUIREMENTS
4. DESIGN DATA MANUAL
5. SPACECRAFT DUTY CYCLE REQUIREMENTS
6. ENTRY SIMULATION
7. LANDING SIMULATION
8. SPACECRAFT METHOD COMPARISON SIMULATION
9. PERSONAL PARACHUTE RECOMMENDATION
10. WIND TUNNEL PROGRAM ON SCHEDULE (26)
11. PARACHUTE DEPLOYMENT ENVELOPES ESTABLISHED
12. AIR LOADS DESIGN DATA COMPLETE (PRELIM)
13. STABILITY & CONTROL DESIGN MOMENTS (PRELIM)
14. PRELIMINARY FLIGHT PLAN

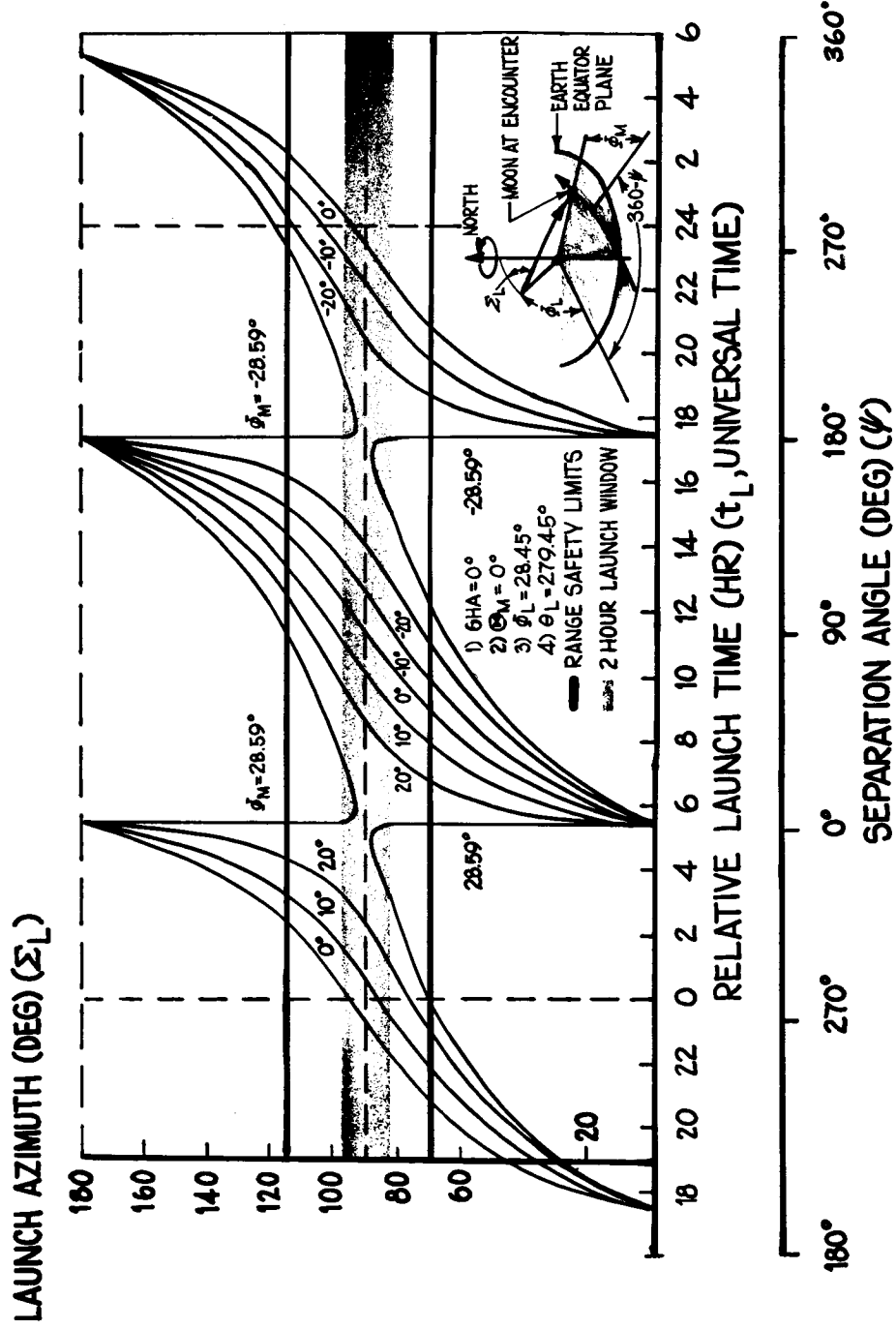
SELECTED TOPICS

1. LAUNCH WINDOW
2. LAUNCH ESCAPE SYSTEM
3. CHARACTERISTIC VELOCITIES
4. EARTH ATMOSPHERE ENTRY
5. STABILITY & CONTROL SERVO

LAUNCH WINDOW

6-62 AP 13755

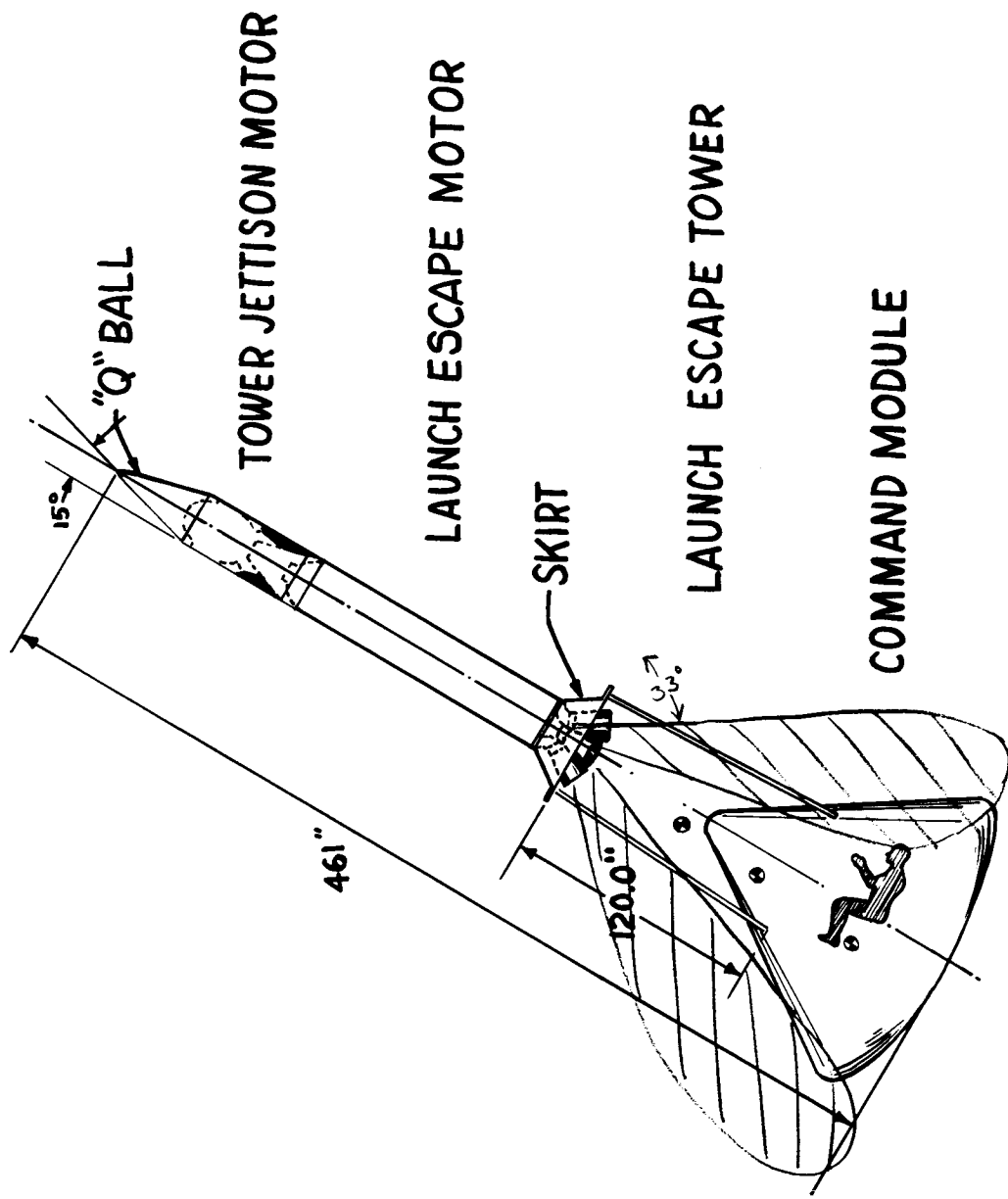
LAUNCH AZIMUTH vs RELATIVE LAUNCH TIME



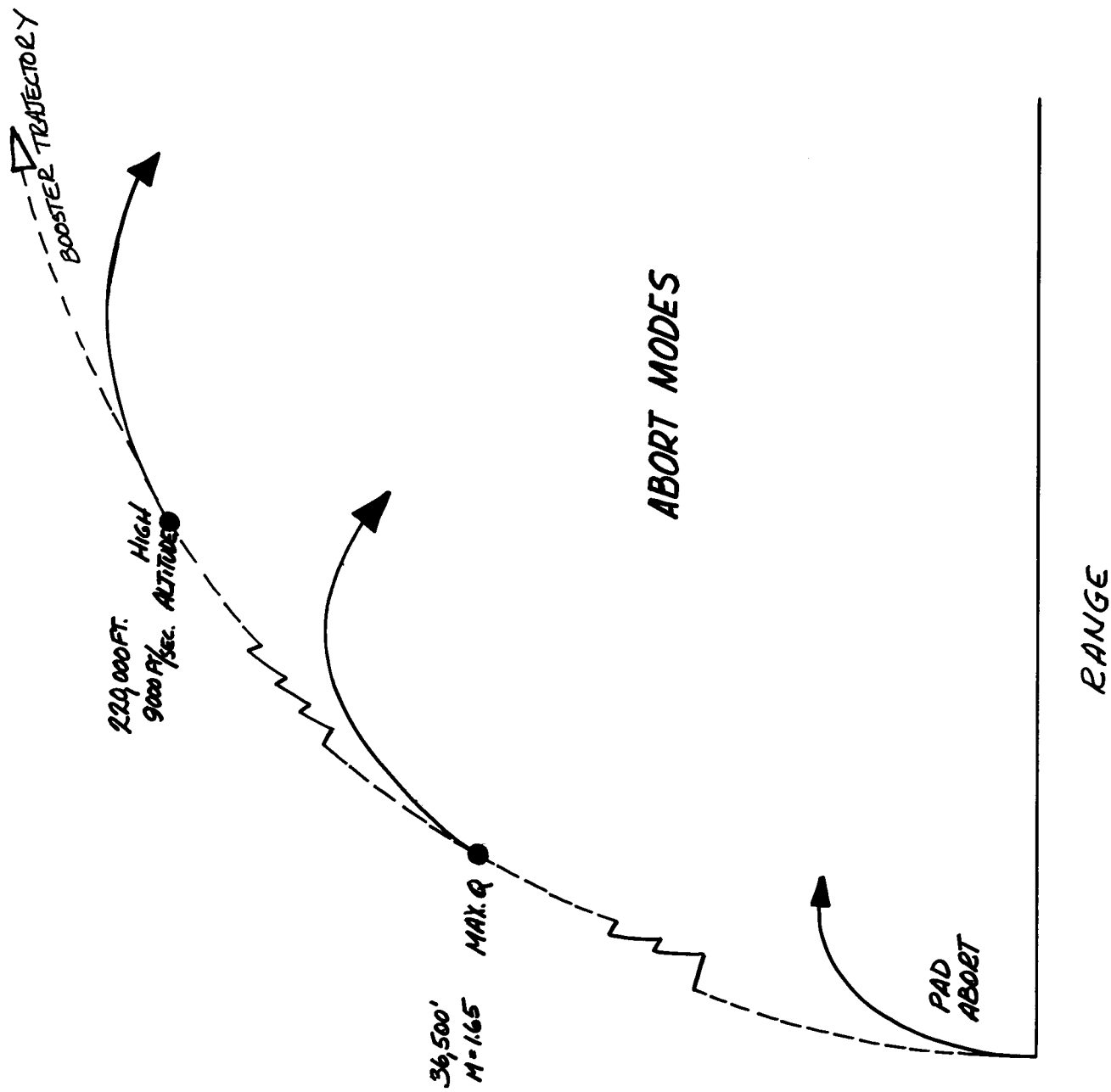
LAUNCH ESCAPE SYSTEM

LAUNCH ESCAPE SYSTEM

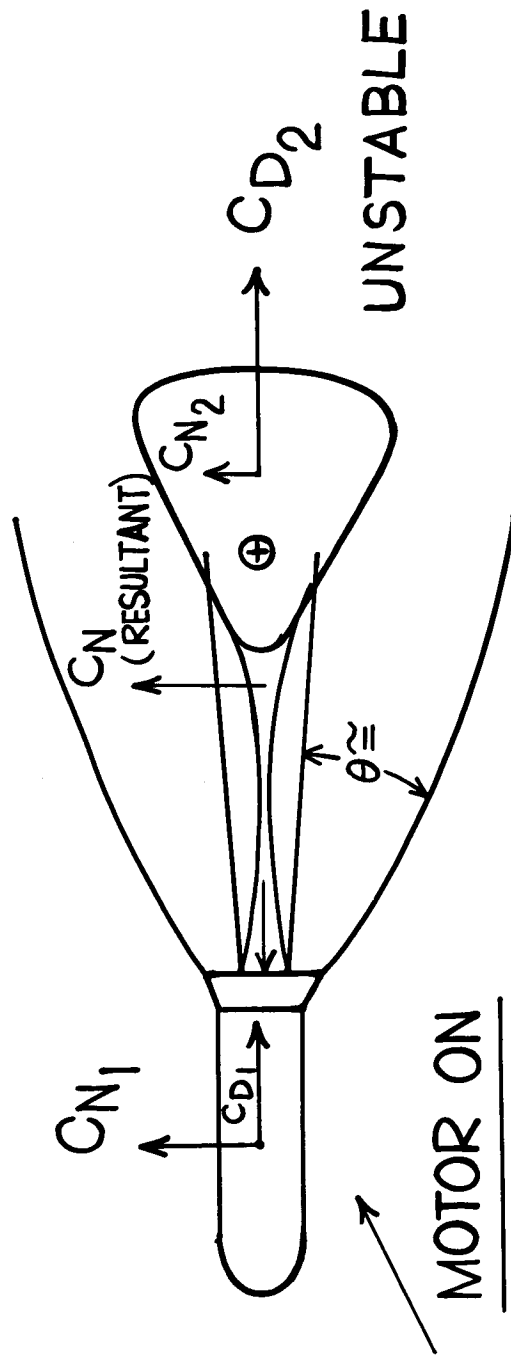
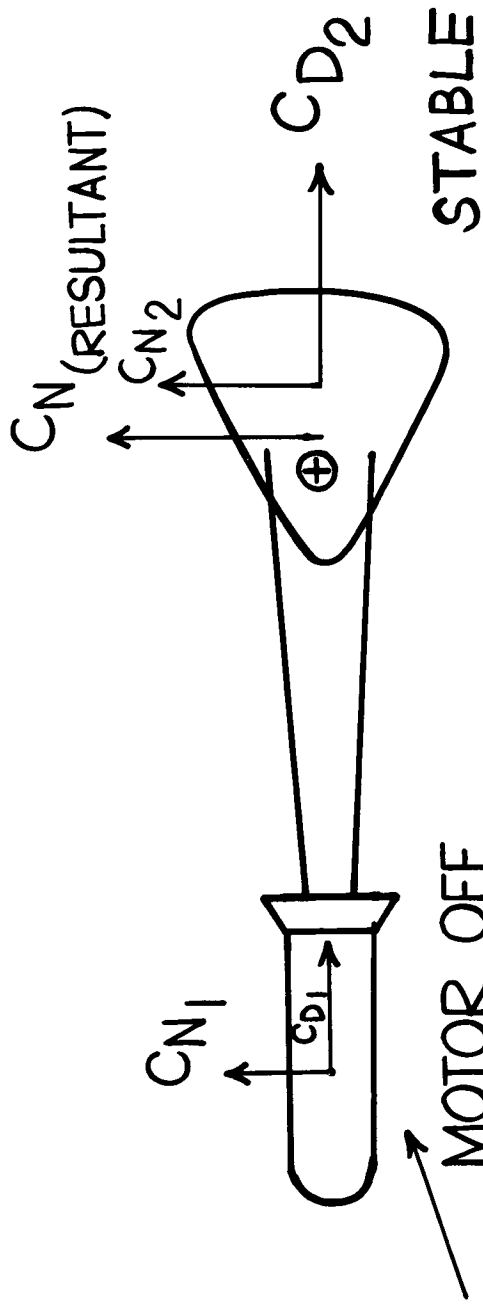
AERODYNAMIC CONFIGURATION



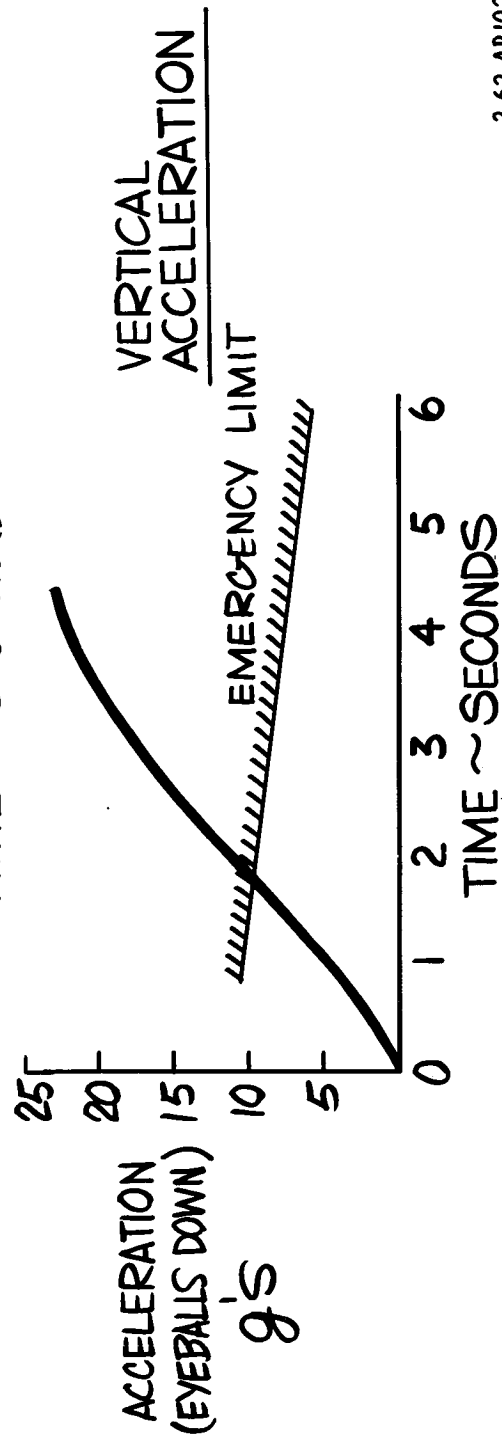
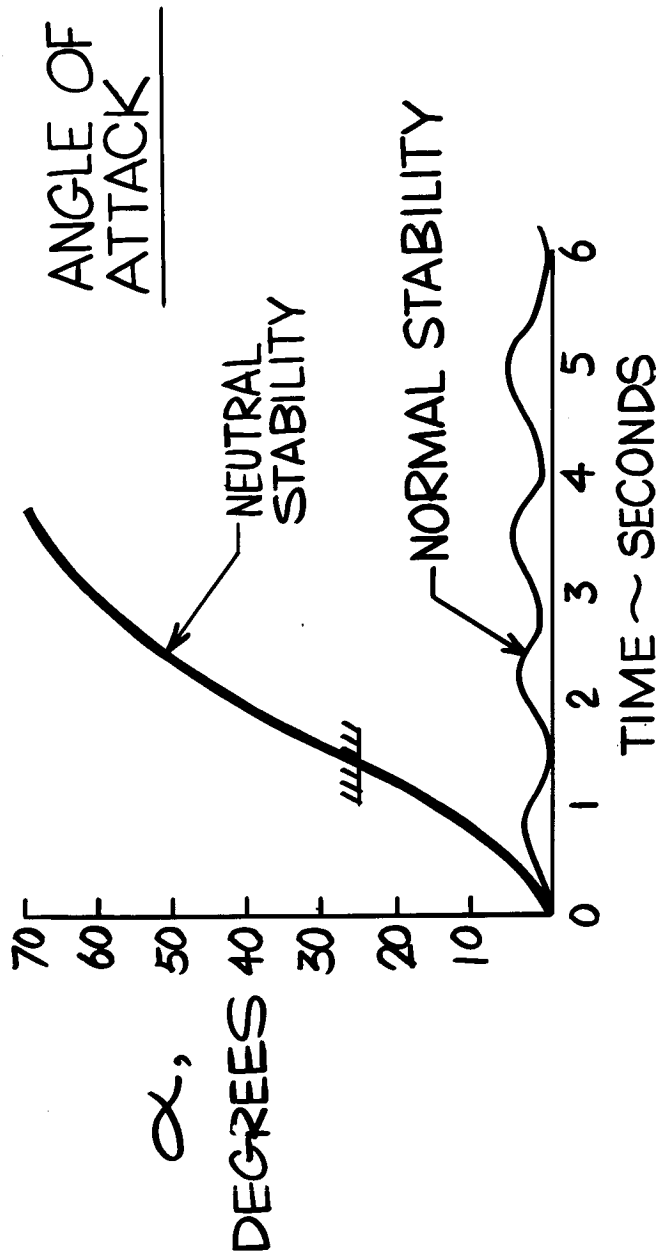
6-62 AP 13476



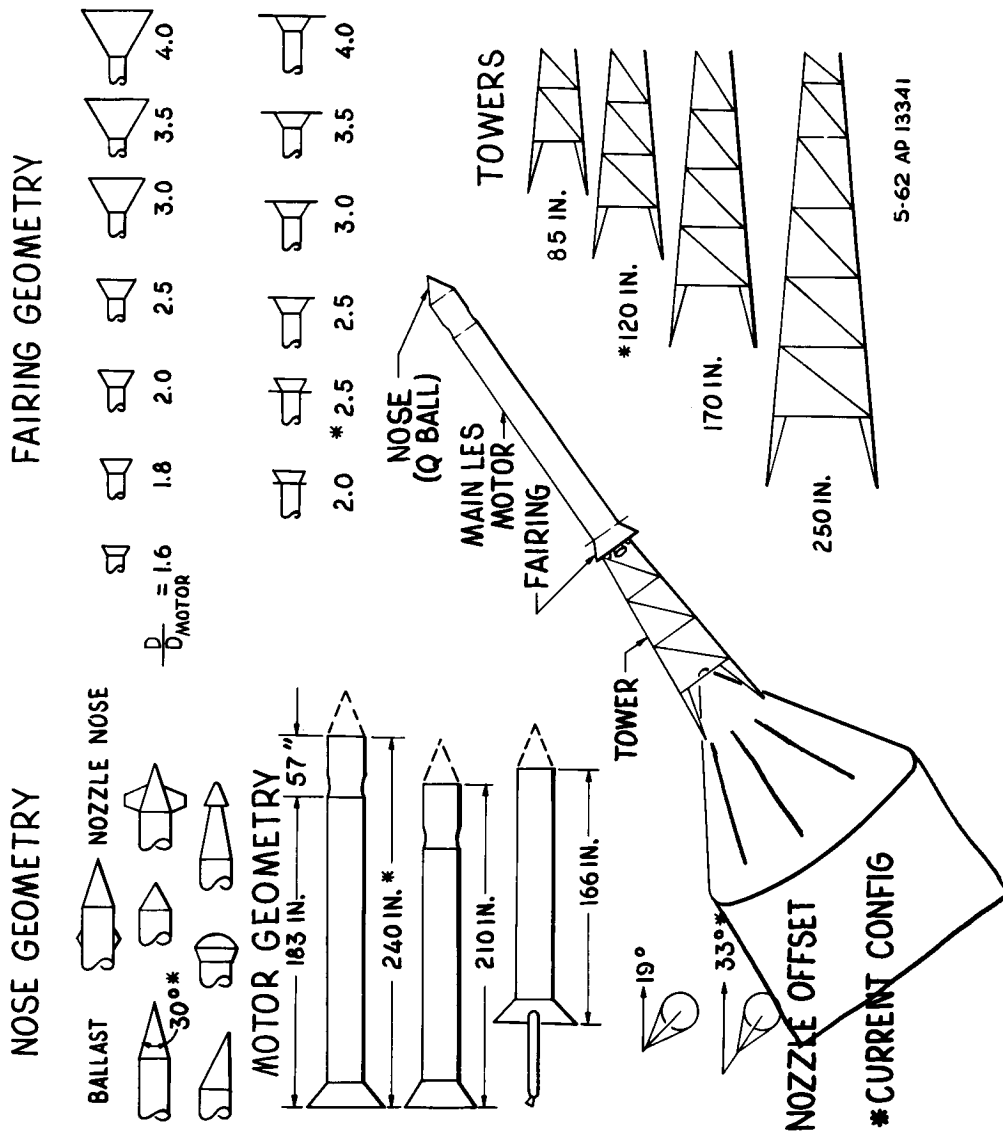
AERODYNAMIC FORCES



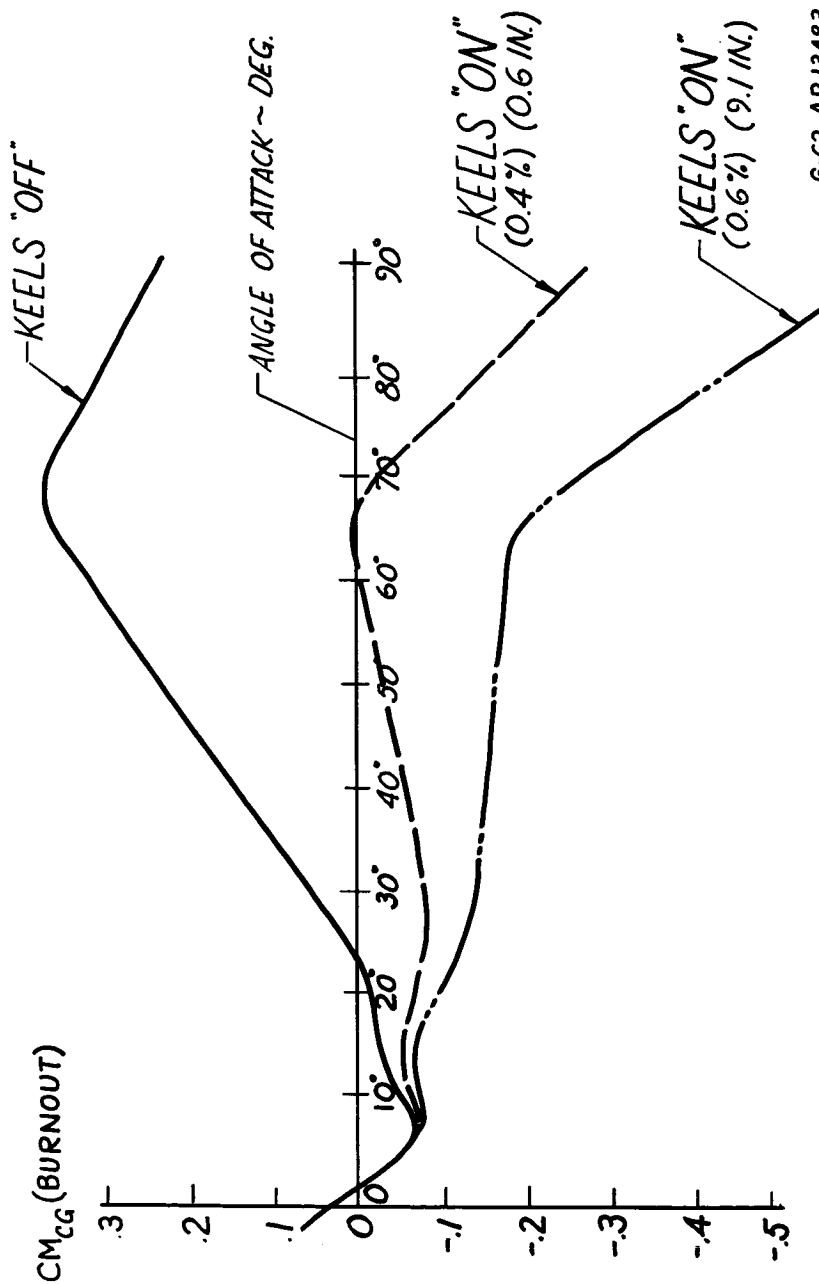
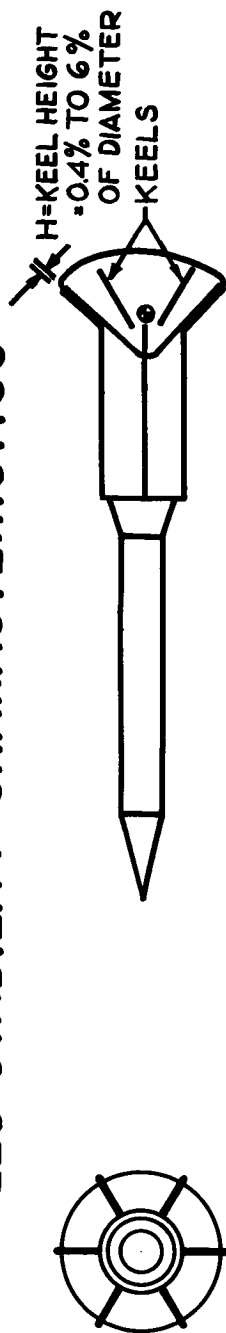
JET EFFECT STABILITY PROBLEM



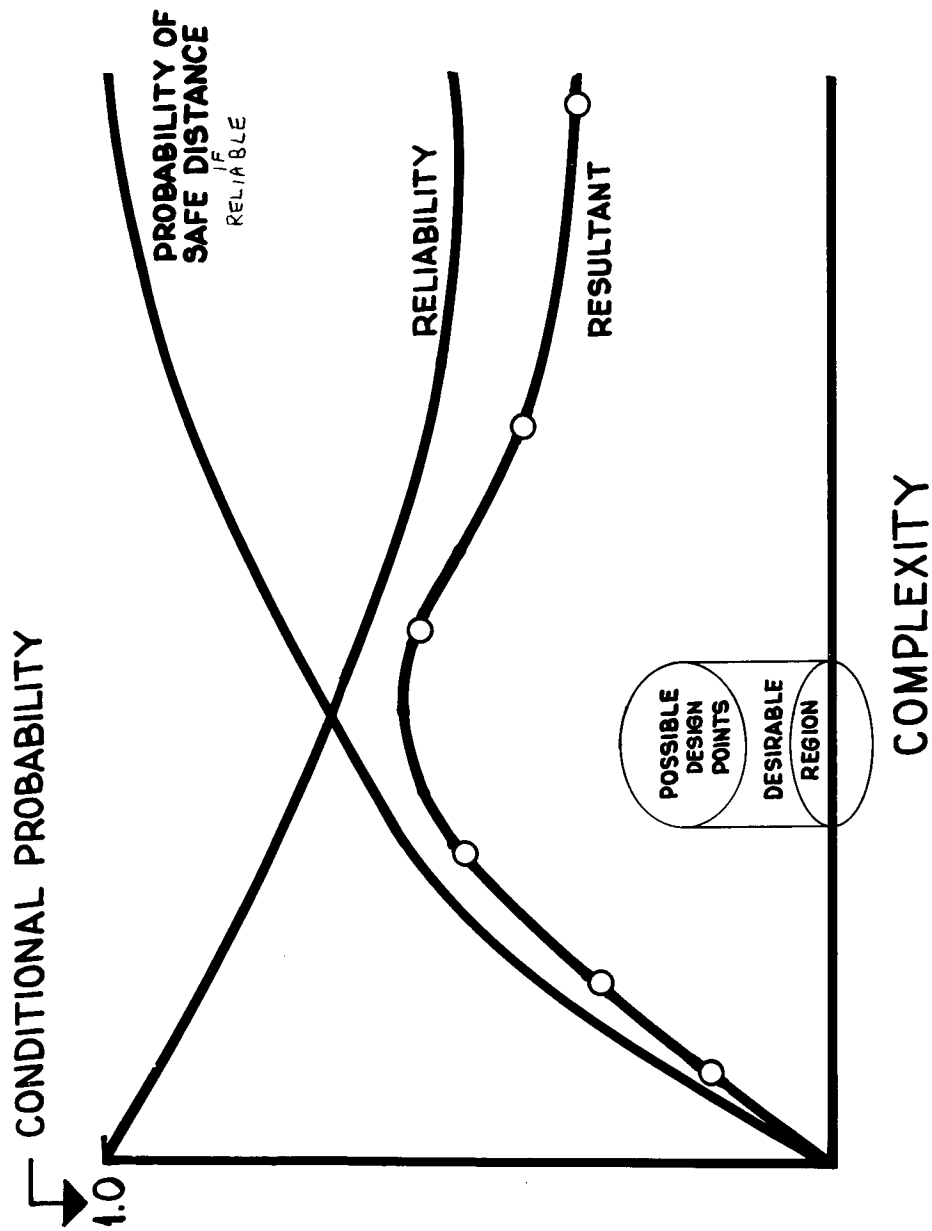
LES CONFIGURATIONS



ESTIMATED EFFECT OF KEELS ON LES STABILITY CHARACTERISTICS



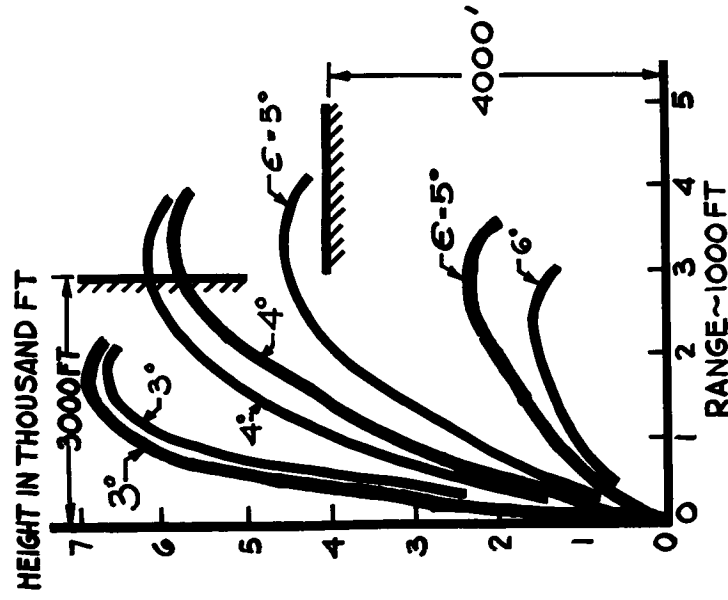
SAFE ABORT VS COMPLEXITY OF SYSTEM



PASSIVE SYSTEM

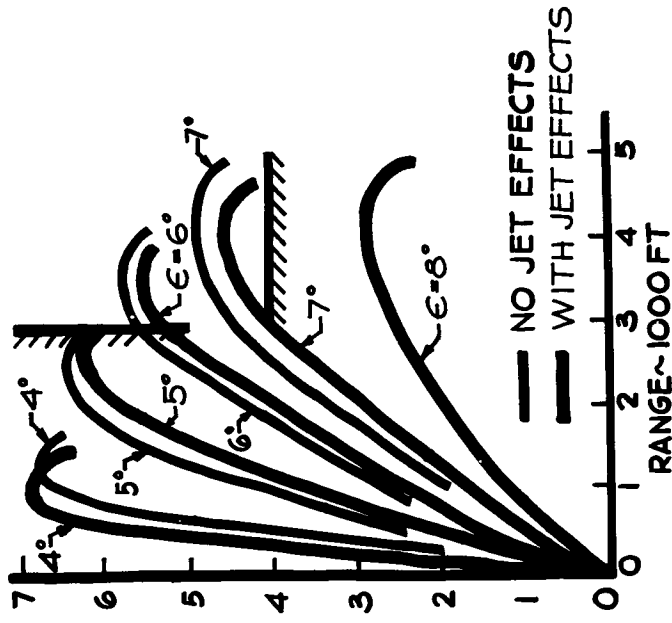
EFFECT OF BALLAST ON PAD ABORT TRAJECTORIES

ZERO BALLAST



1500 LB BALLAST

HEIGHT IN THOUSAND FT.

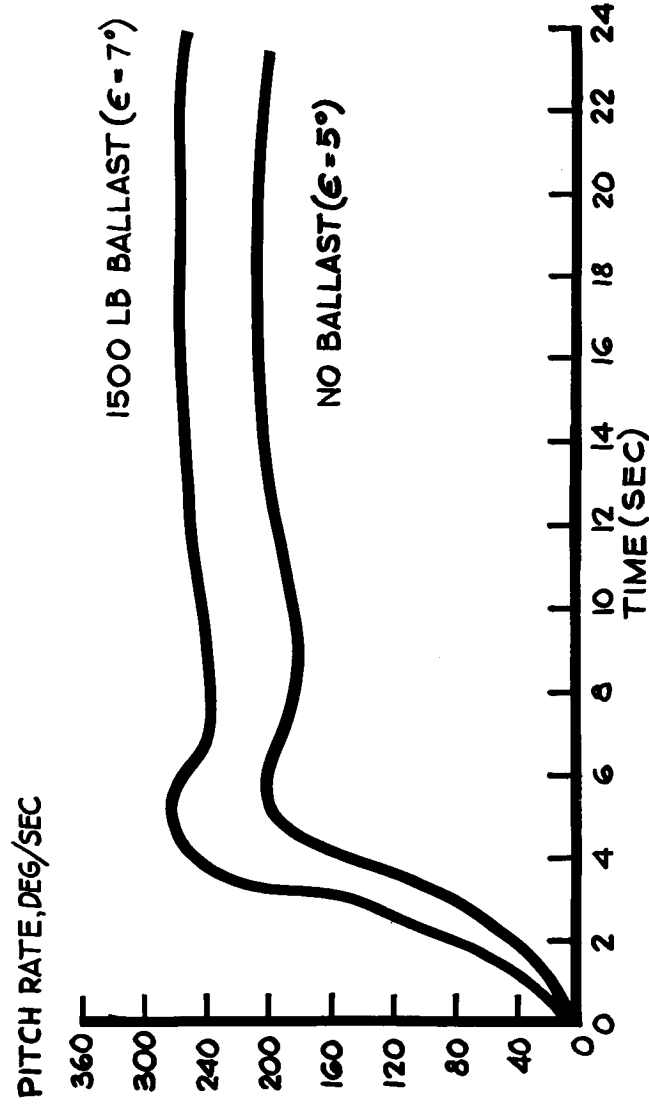


ABOVE SHOWS

- IMPULSE OF LAUNCH ESCAPE MOTOR IS SUFFICIENT EVEN WITH BALLAST
- BALLAST SIGNIFICANTLY REDUCES THRUST ALINEMENT TOLERANCE PROBLEM

PITCHING RATE TIME HISTORY FOR HIGH-ALTITUDE ABORT

(h = 220,000 FT)



HIGH SUSTAINED PITCH RATES

- INTRODUCE HUMAN TOLERANCE PROBLEMS (ACCELERATION & VERTIGO)
 - TENDS TO LOOSE ATTITUDE REFERENCE
 - MAY REQUIRE LARGER C/M REACTION JET AUTHORITY
- PROBLEM MINIMIZED BY EARLY TOWER SEPARATION

CURRENT ANALYSIS EFFORT

PASSIVE SYSTEM

- DYNAMIC ANALYSIS OF POSSIBLE AERODYNAMIC CONFIGURATIONS
- EFFECT OF BALLAST
- EFFECT OF LAUNCH ESCAPE MOTOR BURNING DURATION & THRUST LEVEL
- PROBLEM OF TUMBLING FOR HIGH-ALTITUDE ABORT (ALT > 80,000 FT)

CLOSED-LOOP CONTROL SYSTEM

- STUDIES TOWARD REDUCING AUTHORITY OF PRESENT SYSTEM
 - DEFINITION OF SYSTEM GAINS
- POSSIBILITY OF OPERATING A SATISFACTORY BANG-BANG CONTROL SYSTEM
- EFFECT OF ALTERNATE CONTROL PARAMETERS ($\gamma, \theta, \dot{\theta}, \alpha$, ACCELERATION)
- VEHICLE RESPONSE TO CONTROL SYSTEM FAILURE FOR VARIOUS AUTHORITIES

ALL STUDIES CONSIDER FOLLOWING DISTURBANCES FOR ALL ABORT

CONDITIONS (PAD, MAX $\dot{\gamma}$, HIGH ALTITUDE)

- THRUST ALINEMENT TOLERANCES
- BOOSTER DYNAMIC CONDITION AT ABORT
- GUSTS
- WIND SHEARS

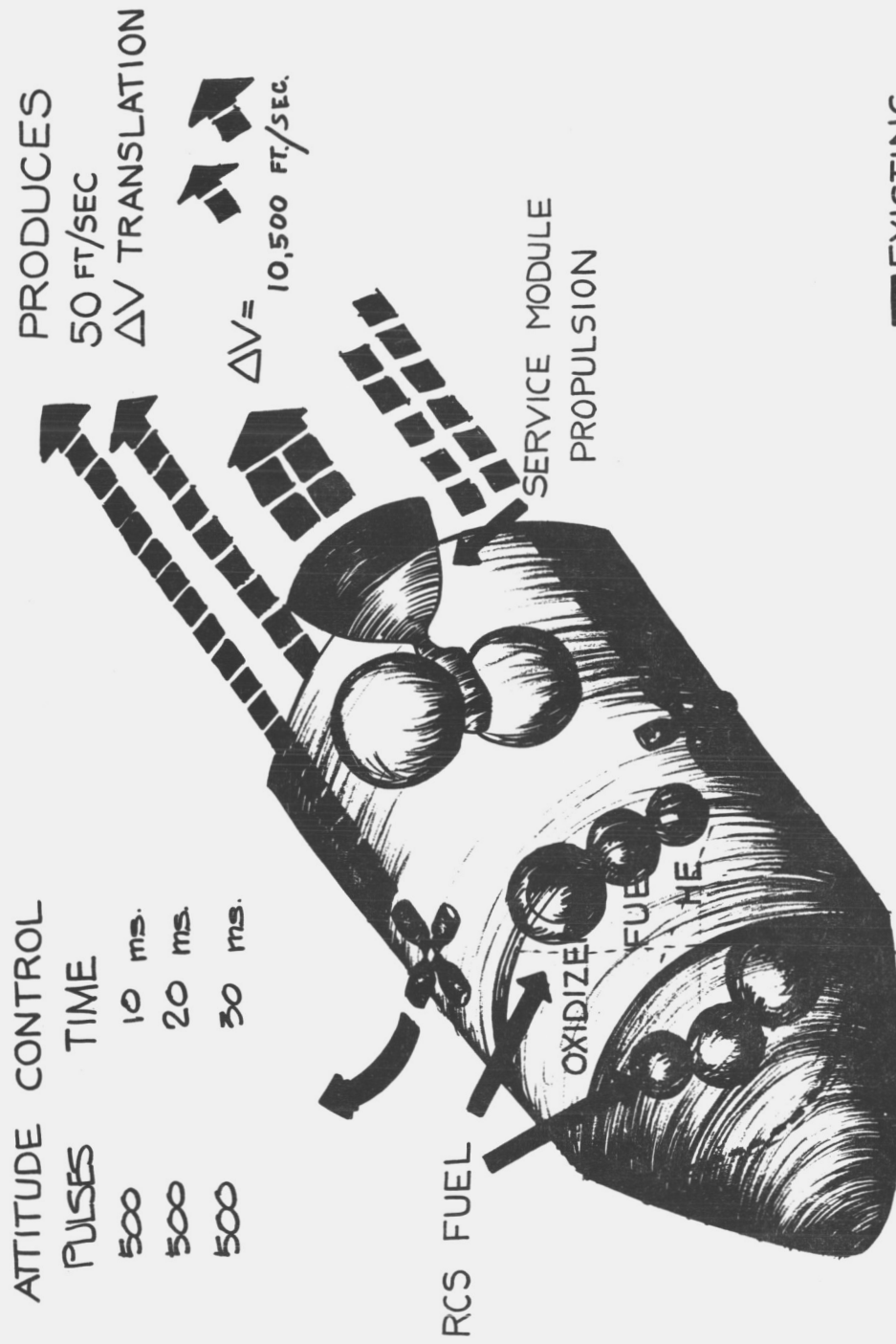
RECOMMENDATIONS

- PROCEED WITH STUDIES TO DEFINE TRADE OFF BETWEEN BALLAST & CONTROL AUTHORITY FOR A RANGE OF POSSIBLE JET EFFECTS & AERODYNAMIC CONFIGURATIONS
- EXPEDITE JET-ON WIND TUNNEL TEST DATA (LANGLEY)
- SIMPLIFY DESIGN REQUIREMENTS WHEREVER POSSIBLE
- MECHANIZE BOILERPLATE HARDWARE WITH SUFFICIENT FLEXIBILITY TO PROVIDE A SATISFACTORY ABORT SYSTEM TEST
- STRIVE FOR MINIMUM AUTHORITY FAIL SAFE CONTROL SYSTEM

$$\Delta V = f(p_H, p)$$

-REDUNDANT MID-COURSE CORRECTION-

SERVICE MODULE-RCS SYSTEM

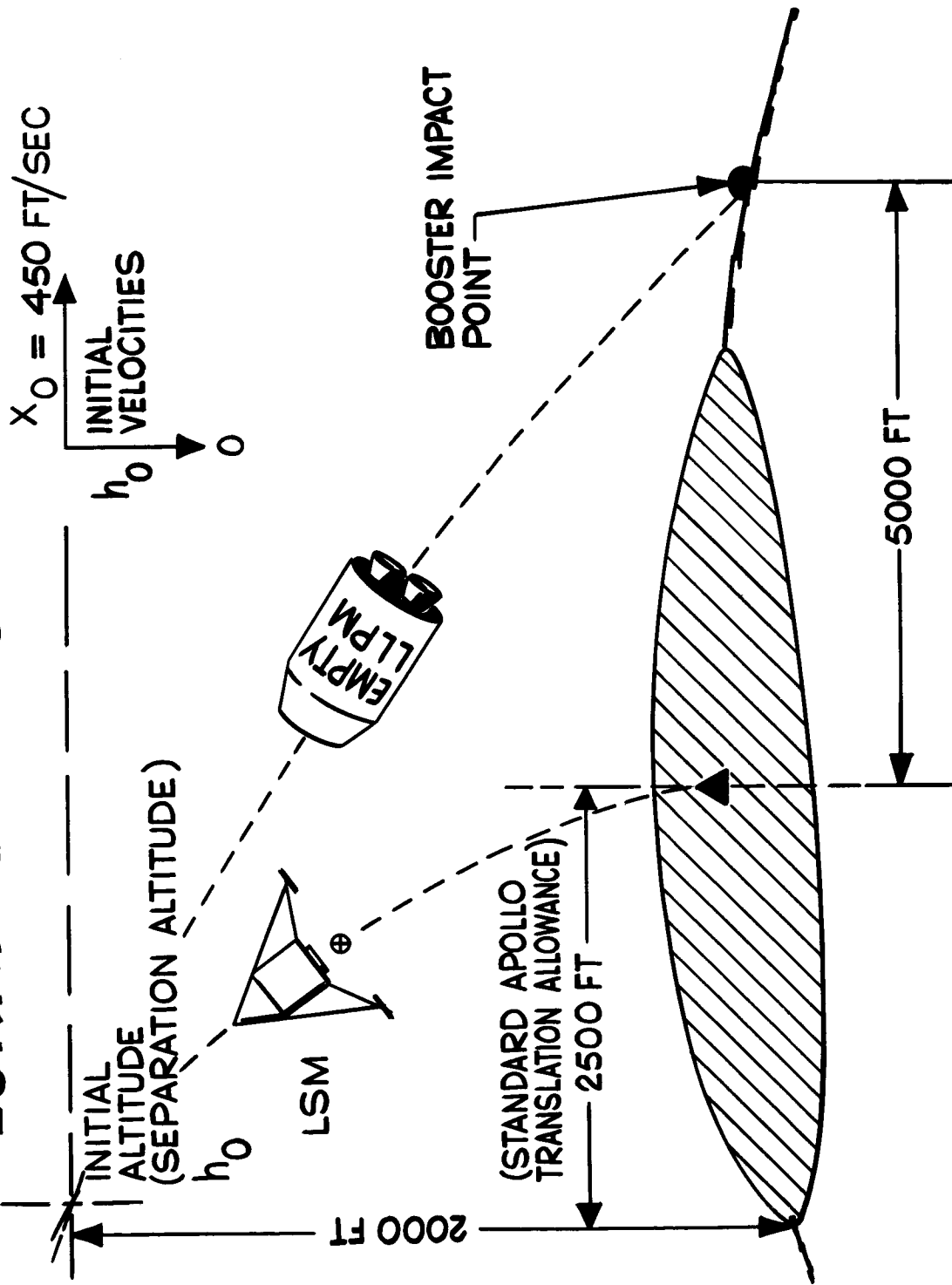


■ EXISTING
■ PROPOSED
■ INCREASE

LUNAR LANDING SIMULATION

6-62 AP 13758

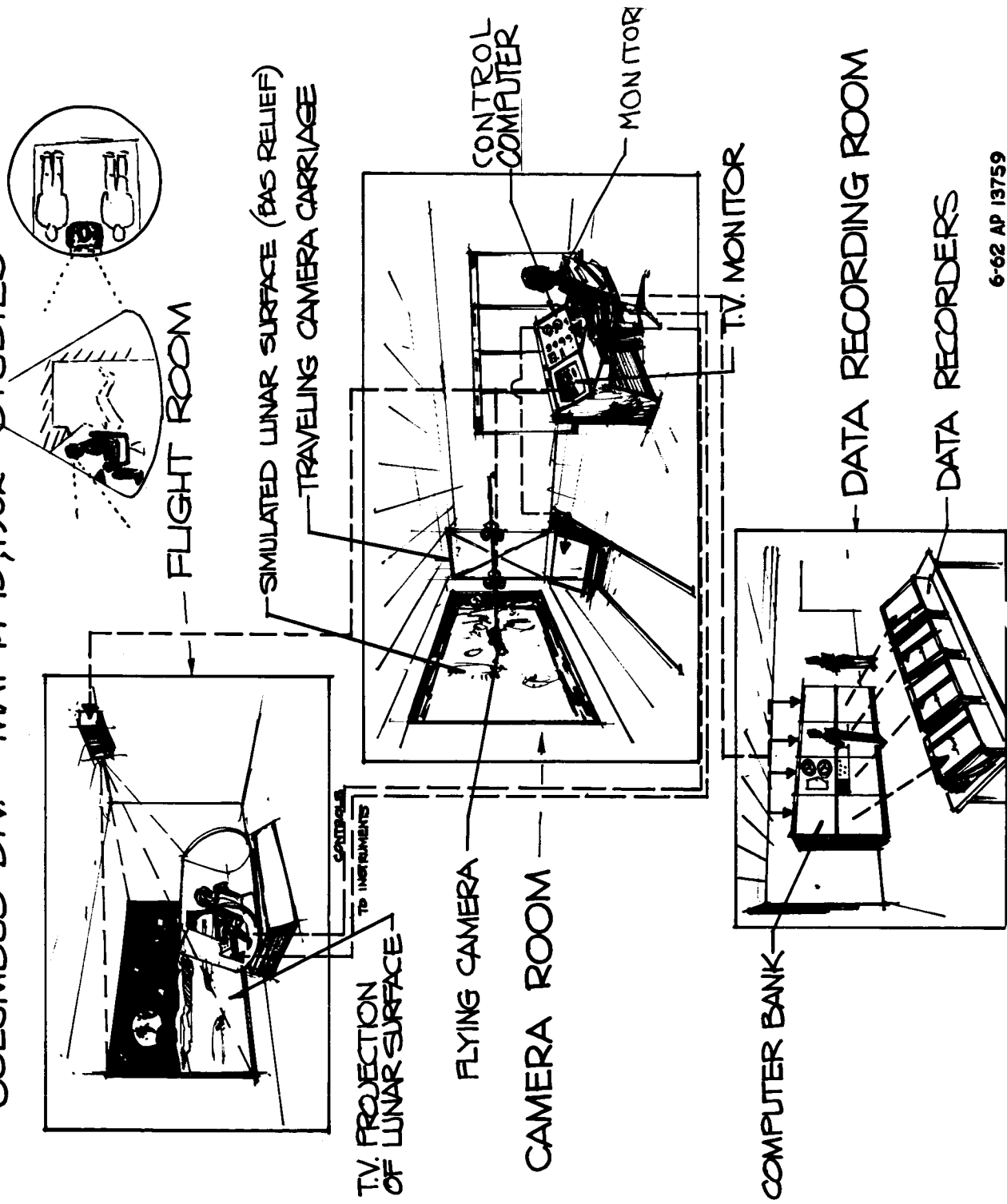
LUNAR LANDING TRAJECTORY



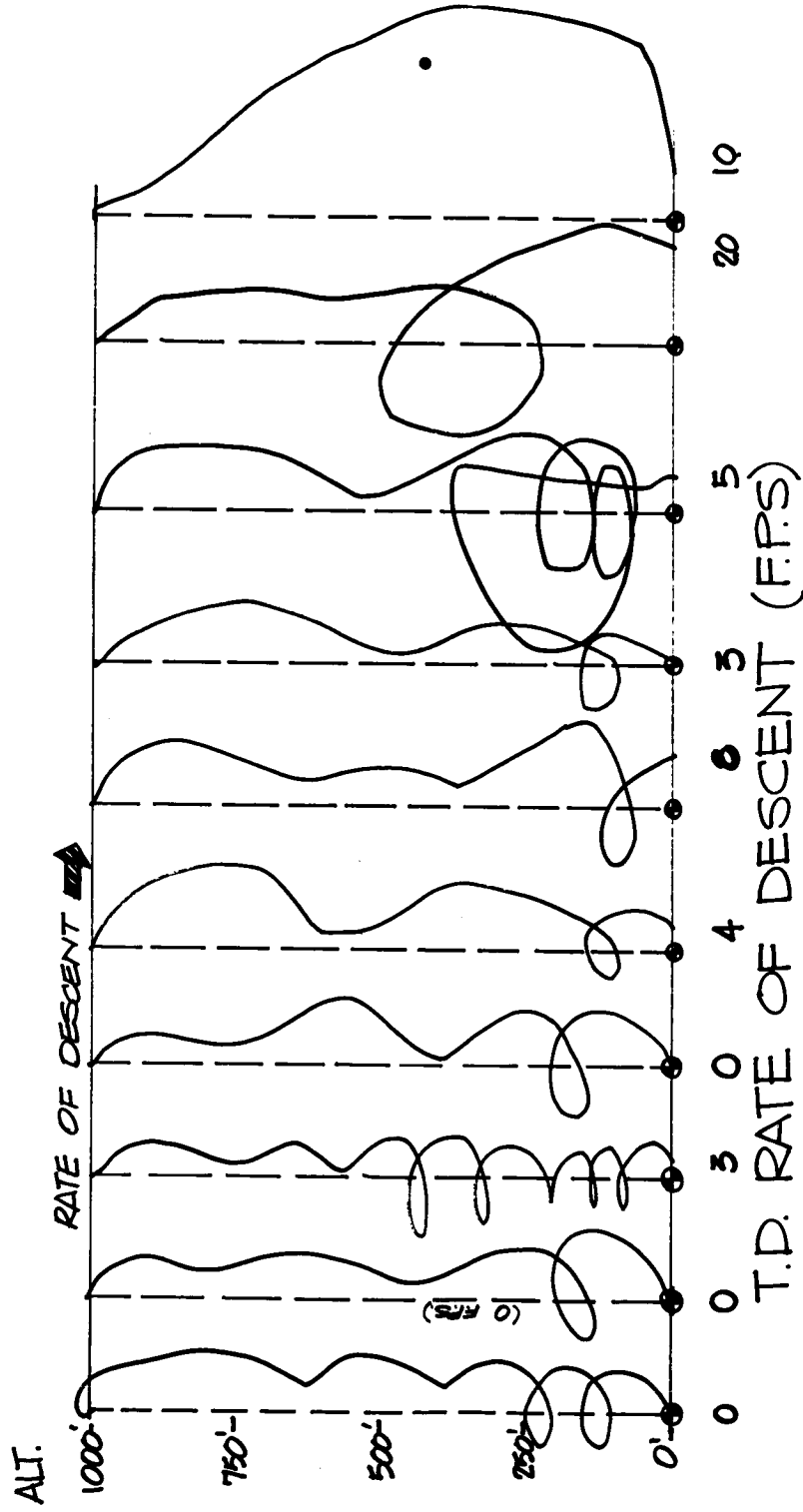
4-62 AP 11925

LUNAR LANDING SIMULATION FACILITY

COLUMBUS DIV. - MAY 14-15, 1962 STUDIES

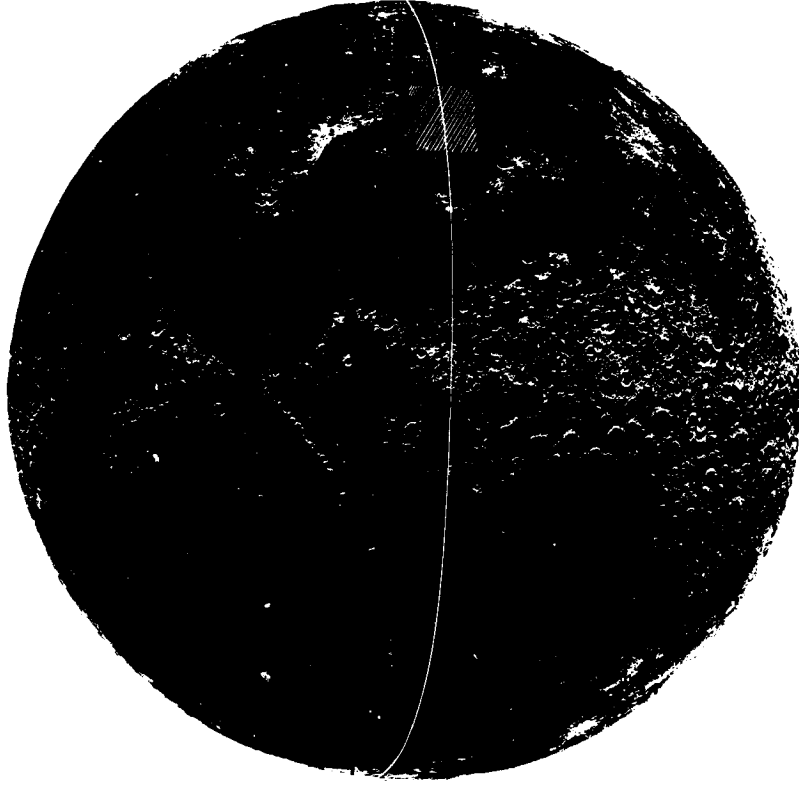


10 SIMULATED FLIGHTS BY RON GERDES (NASA)



6695* 6039* 8806* 5077* 5755* 4941* 5959* 9262* 5453* 2746*
FUEL CONSUMED

LUNAR LANDING LOCATION

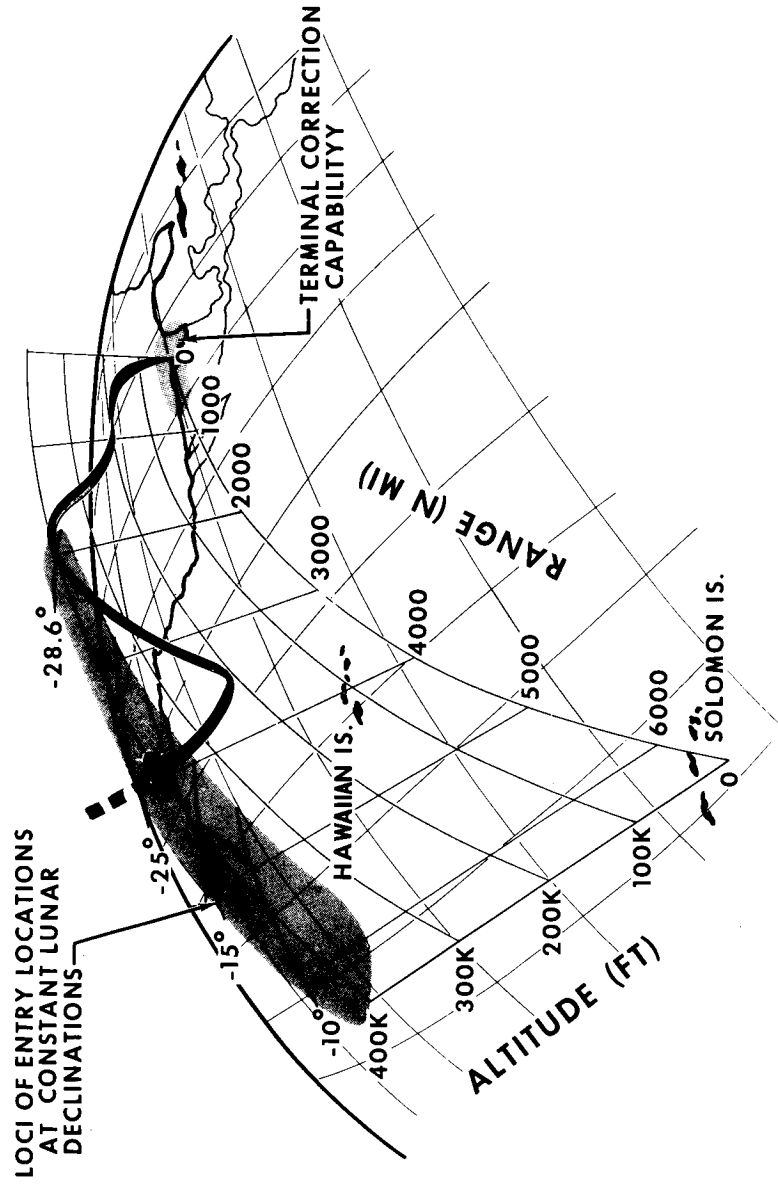


6-62 AP 13597

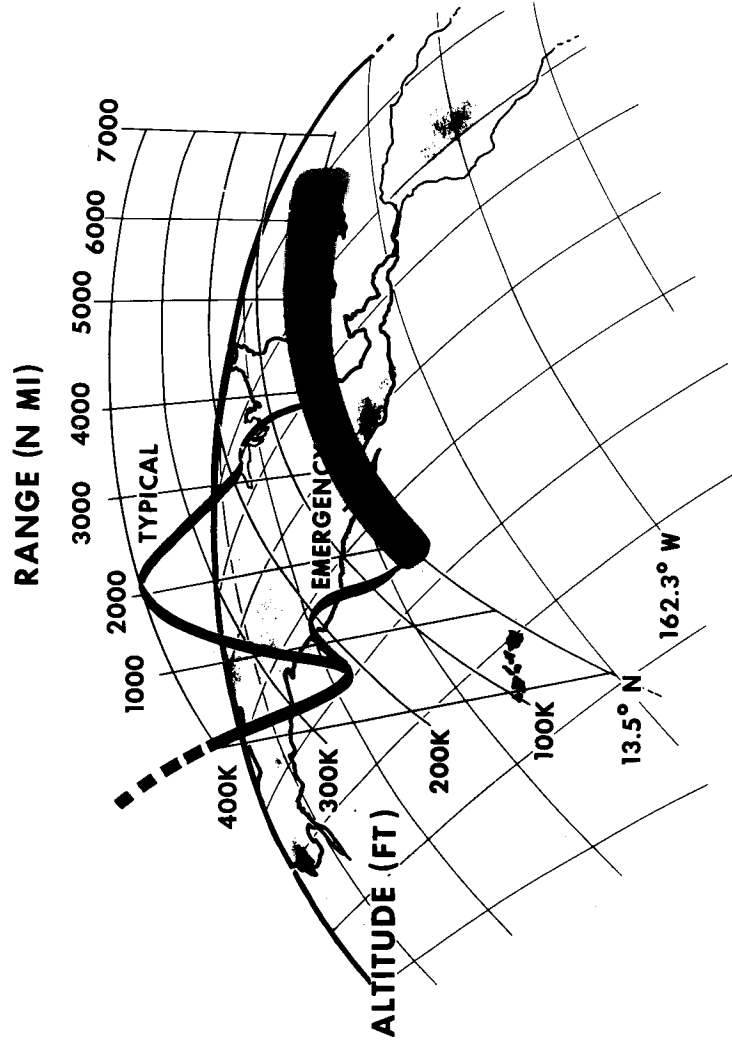
EARTH ATMOSPHERIC ENTRY

5-62 AP 13321

ENTRY RANGE REQUIREMENTS



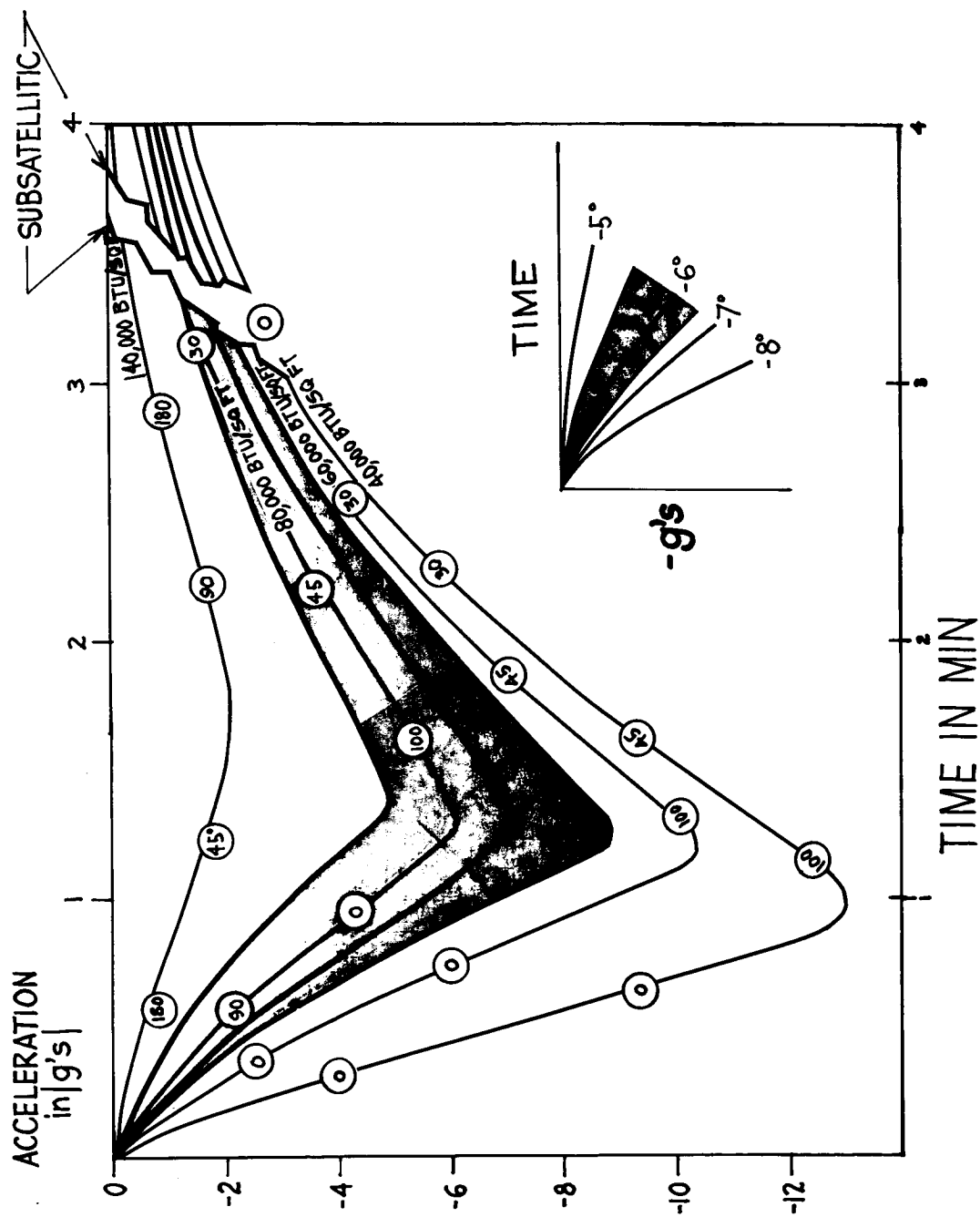
ENTRY RANGE CAPABILITY



NORTH AMERICAN AVIATION, INC.
SPACE AND INFORMATION SYSTEMS DIVISION

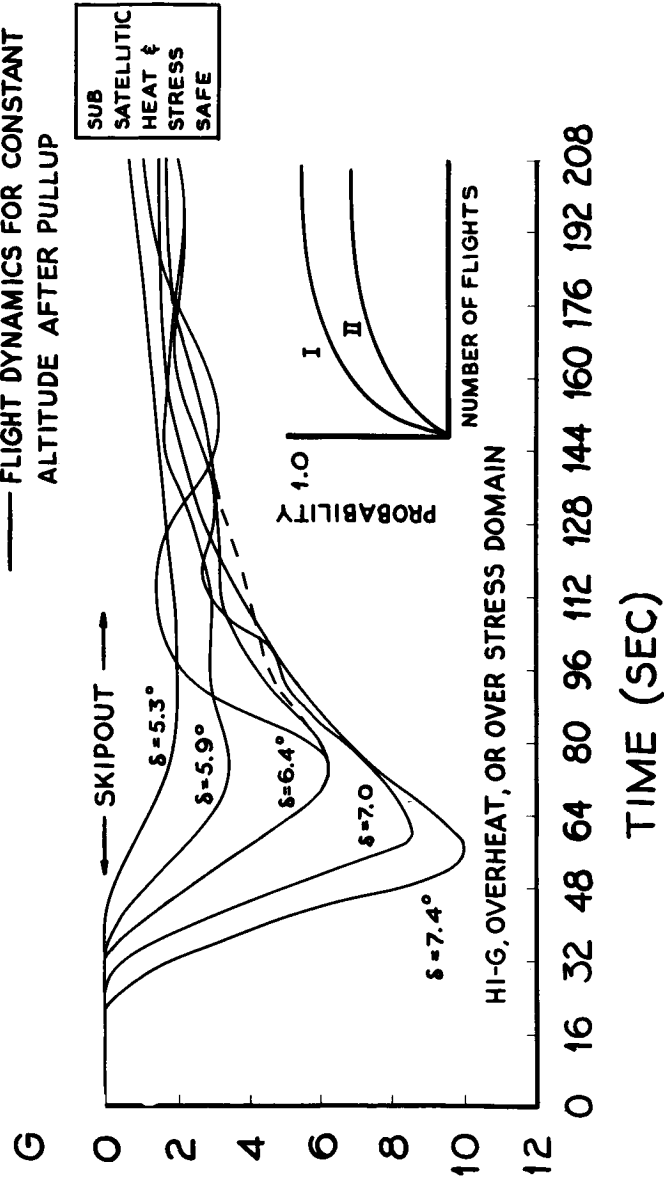
4-62 AP 12060A

ENTRY TRAJECTORIES



ENTRY FLIGHTS

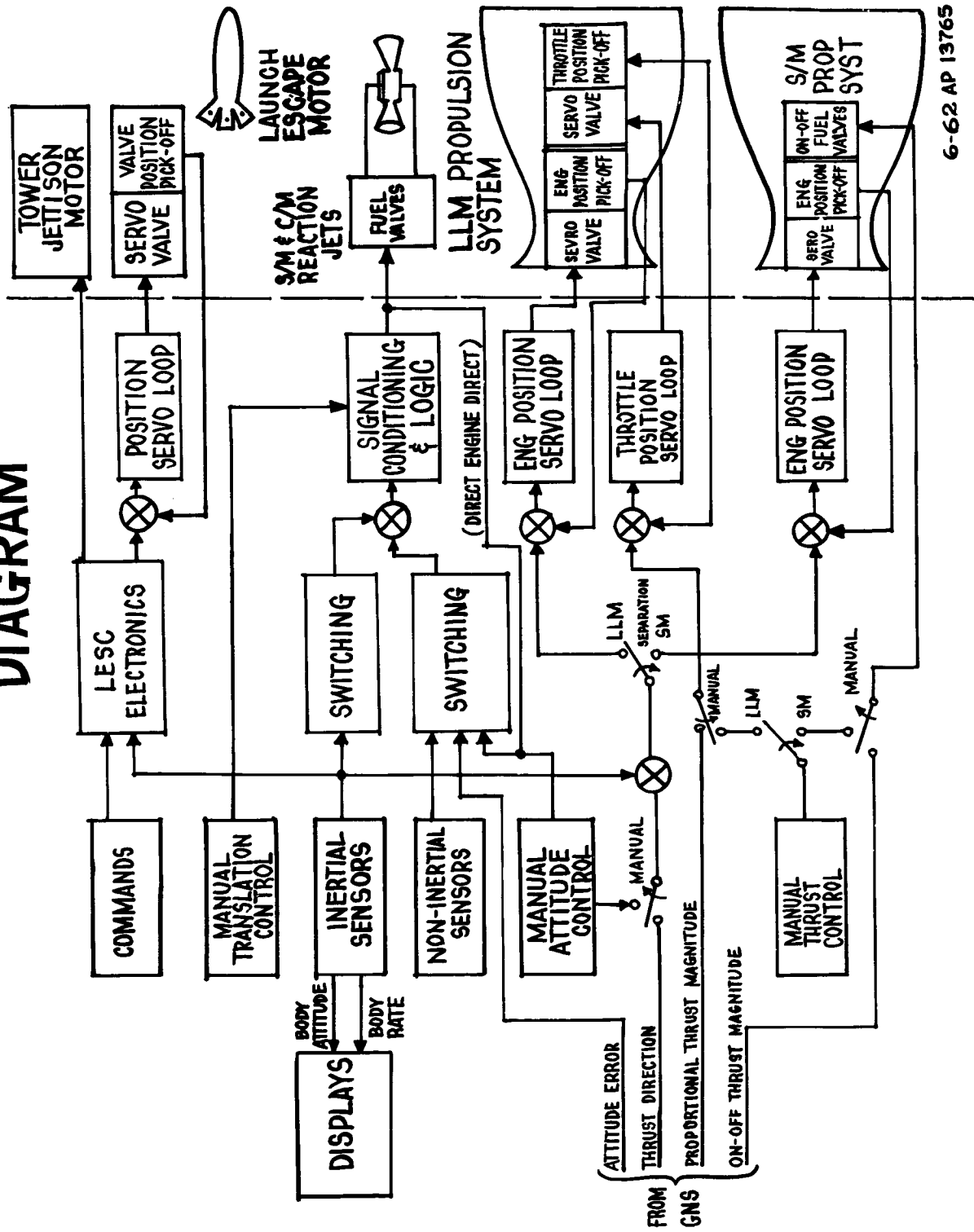
$h_0 = 400,000$ FT
 $V_0 = 36,080$ FPS
 $\phi = 0^\circ$ UNTIL PULLUP-LIFT VECTOR UP
 — FLIGHT DYNAMICS FOR CONSTANT ALTITUDE AFTER PULLUP

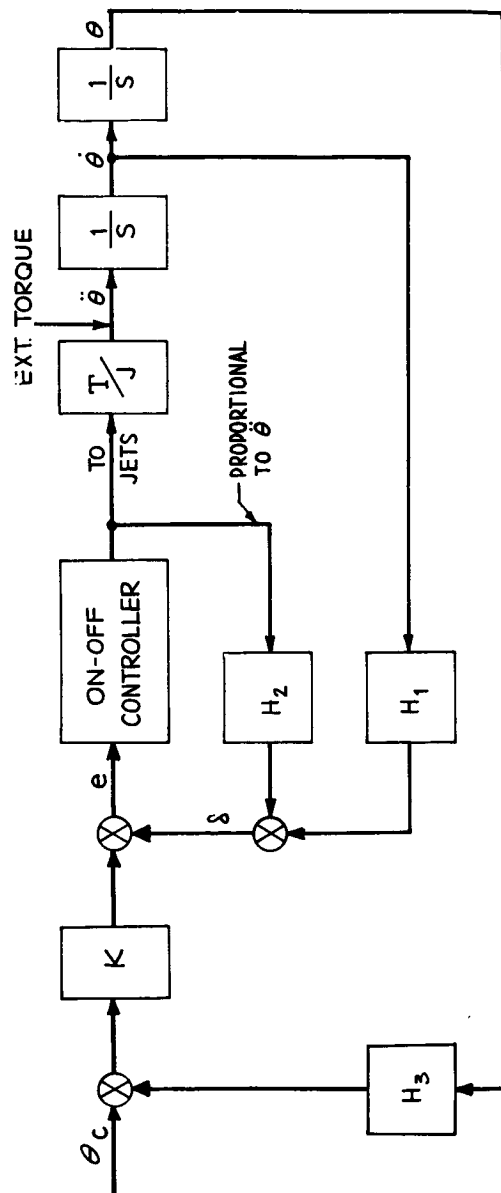


STABILITY & CONTROL SERVO

6-62 AP 13762

STABILIZATION & CONTROL FUNCTIONAL BLOCK DIAGRAM





IT IS DESIRED THAT :

$$(1) \quad \dot{\theta} = \kappa, \dot{\theta}$$

IN THIS DIAGRAM:

$$(2) \delta = \ddot{\theta} H_2 + \dot{\theta} H_1 = \dot{\theta} (SH_2 + H_1)$$

THEN (1) CAN BE SATISFIED IF :

$$(3) \text{SH}_2 + \text{H}_1 = \text{K}_1$$

Ö

$$(4) \quad H_2 = \frac{K_1 - H_1}{S}$$

BY CHOOSING:

$$H_1 = \frac{K_1}{T_1 S + 1}$$

NEH:

$$H_2 = \frac{K_1 - \left(\frac{K_1}{T_1 S + 1} \right)}{S} = \frac{K_1 T_1}{T_1 S + 1}$$

$\therefore S = K_1 \theta$ Q.E.D.

5-62 AP 13343

ITEMS THAT MAY BE REPORTED AT NEXT PROGRESS REPORT

- 1. IN-FLIGHT TEST LOGIC**
- 2. LAUNCH ESCAPE DESIGN RECOMMENDATION**
- 3. ENTRY RANGE RECOMMENDATION**
- 4. PLAN FOR 14-DAY MISSION IN C/M AT 7 PSI (50-50)**
- 5. FLIGHT PLAN ERROR ANALYSIS RESULTS**
- 6. JET EFFECTS (WIND TUNNEL) RESULTS**
- 7. TELECOMMUNICATIONS DESIGN**
- 8. STABILITY & CONTROL DESIGN**